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# 10<sup>th</sup> Class

# BIOLOGY



Subject : Biology

Class : X (CBSE )

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# NUTRITION

## 1.1 NUTRITION :

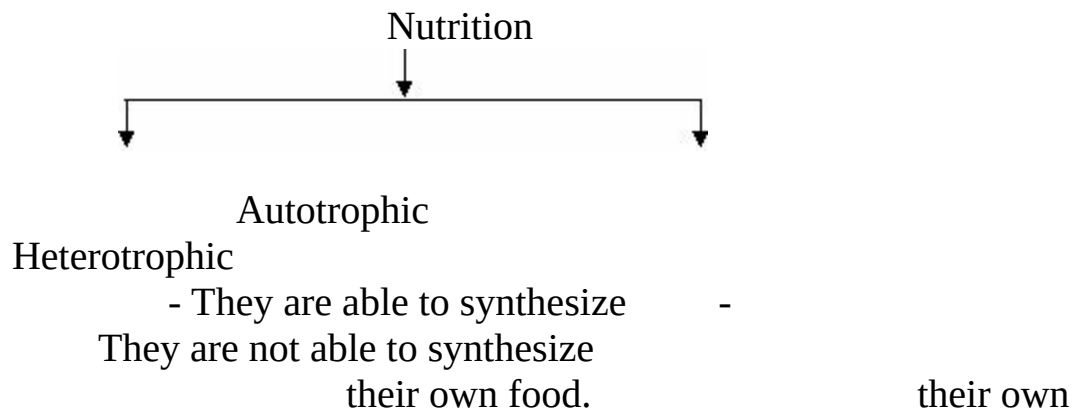
“**Nutrition**” is a process of intake as well as utilization of nutrients by an organism. It is the process of breakdown of nutrients into smaller molecules and their absorption. Food provides us nutrition and energy. It contains different types of nutrients in varying amounts according to the need of our body.

### 1.1 (a) Nutrients :

These are the substances required by our body for its growth, repair, work and maintenance of the body. Different types of nutrients are carbohydrates, fats, proteins, vitamins, mineral etc. Our daily energy need may vary according to our occupation, age, sex and under some specific conditions.

## 1.2 MODES OR NUTRITION :

There are several modes of nutrition on the basis of which organisms are classified as follows :



food.

### 1.2 (a) Autotrophic :

**(Auto = self, trophic = food)** It is a mode of nutrition in which organisms prepare their own food. Inorganic molecules like CO<sub>2</sub> and H<sub>2</sub>O are converted into organic molecules like carbohydrates in the presence of sunlight and chlorophyll. **e.g. Green plants.** Autotrophs are further categorized. as :

**(i) Photoautotroph :** Those which utilize sunlight for preparing their food

**(ii) Chemoautotroph :** Those which utilize chemical energy for preparing their food.

### 1.2 (b) Heterotrophic :

**(Hetero = different ; trophic = food)** It is a mode of nutrition in which organisms derive their food from some other animals or plants. They cannot prepare their own food **e.g. human being.** Heterotrophs are further categorized depending on the nature of food they consume :

**(i) Herbivores :** Animals which eat only plants, **e.g. Cow, goat** etc.

**(ii) Carnivores :** They feed on flesh of other animals, **e.g. Lion, vulture** etc.

**(iii) Omnivores :** They feed on plants and animals both **e.g. Dog, human** etc.

**(iv) Detritivores :** Feed on detritus or dead organic remains, **e.g. Earthworm** etc.

**(v) Sanguivorous :** Feed on blood **e.g. Leech, female mosquito** etc.

**(vi) Frugivorous :** Feed on fruits, **e.g. Parrot** etc.

**(vii) Insectivores :** Feed on insects, **e.g. Bats** etc.

### 1.2 (c) On the Basis of Mode of Feeding Organisms are Categorized As :

**(i) Holozoic :** They ingest mostly solid but sometimes liquid food. **e.g.,**

**Amoeba, human** etc.

(ii) **Saprotrophic** : they absorb organic matter from dead and decaying organisms with the help of their enzymes. **e.g., Bacteria, fungi** etc.

(iii) **Parasitic** : They derive their nutrition from other living plants or animals e.g. **Plasmodium round worms** etc.

Nutrition can be divided into two categories on the basis of occurrence

Nutrition in animals

Nutrition in plants

Nutrition

### 1.3 Nutrition in Plants:

- Plants are autotrophic in nature. They prepare their own food hence they are called as **producers**.

- They contain a green pigment called chlorophyll which can entrap solar energy which is then converted into chemical energy in the form of food and the process is called as “**Photosynthesis**”.

#### 1.3 (a) Photosynthesis :

(i) **Definition** : The synthesis of organic compounds like glucose from simple inorganic molecules like CO<sub>2</sub> and H<sub>2</sub>O by the cells of green plants having chlorophyll in the presence of sunlight is called as photosynthesis.

(ii) **Equitation of photosynthesis** : Photosynthesis is a two step process.



(A) **Light reaction** : AT, NADPH<sub>2</sub> and O<sub>2</sub> are produced.

(B) **Dark reaction** : CO<sub>2</sub> & H<sub>2</sub>O are converted into glucose.

- Photosynthesis essentially requires two things :

#### 1.3 (b) Sunlight :

- For plants sun the basis source of radiant energy.

- Plants utilize the light in the visible region of solar spectra (electromagnetic spectrum) which comes under the range of 390 nm - 780 nm.
- Visible region consists of white light which is a mixture of 7 lights of different wavelengths.

- Maximum photosynthesis occurs in red region.
  - There is minimum photosynthesis in green region because green parts of plants reflect whole of the green light.

### 1.3 (c) Chlorophyll :

These are the green pigments present in chloroplast. They are found in green leaves in a maximum amount as well as in other green aerial parts of plant. There are six different types of chlorophyll, they are chlorophyll a,b,c,d,e and bacteriochlorophyll, amongst them chlorophyll a and chlorophyll b are the most commonly occurring chlorophylls.

• Besides chlorophyll certain other pigments are also present in plants like.

**(i) Carotenes :** Orange in colour **e.g. Carrot.**

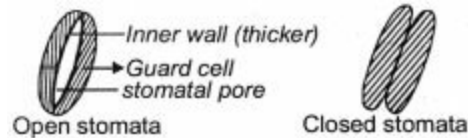
**(ii) Xanthophylls :** Orange yellow in colour **e.g. Maize.**

**(iii) Phycobilins :** Different colour like red, violet **e.g. Blue-green algae, brown algae** etc.

### 1.3(d) Raw Materials of Photosynthesis :

**(i) Carbondioxide :** Terrestrial plants obtain carbon dioxide from the

atmosphere through the small openings present on leaves called as stomata. '**Stomata**' are the small pores present on the surface of leaves. They help in exchange of gases and water. Stomata opening is guarded by the presence of guard cells (kidney shaped). Aquatic plants obtain  $\text{CO}_2$  dissolved in water through their general body surface so they perform more photosynthesis than terrestrial plants.



**(ii) Water :** Plants absorb water from the soil by the process of osmosis. This water is transported to leaves by a special type of tissue called as **xylem**.

- Plants utilize carbon dioxide during photosynthesis, the intensity of light at which amount of  $\text{CO}_2$  used during photosynthesis becomes equal to the amount of  $\text{CO}_2$  released during respiration by plants in called as **Compensation point**.

- Compensation point occurs at low light intensity that is during morning and during evening hours.

### **1.3 (e) Site Photosynthesis :**

Site of photosynthesis is different in prokaryotes and eukaryotes.

- **In prokaryotes :** Photosynthesis occurs in lamellar chromatophores.
- **In eukaryotes :** Photosynthesis occurs in chloroplast.
- **Exception : Fungi** ( It lacks chlorophyll so no photosynthesis occurs here).

- In higher plants chloroplast is the main site of photosynthesis.
- Chloroplast is also called as green **plastid**.
- Plastid was first observed by **Haeckel**.
- Plastids are of 3 different types on the basis of pigments present in them.

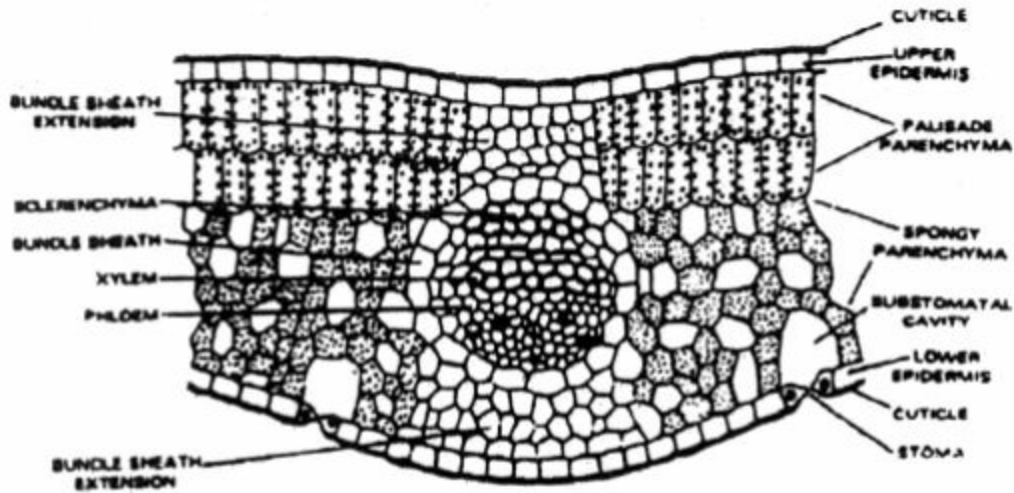
**(i) Leucoplast :** White in colour, found in underground parts, lacks and coloured pigment. Helps in storage of protein (Aleuroplast), oil (Elaioplast), starch (Amyloplast)

**(ii) Chloroplast :** Colour other than green found in aerial parts on the plants

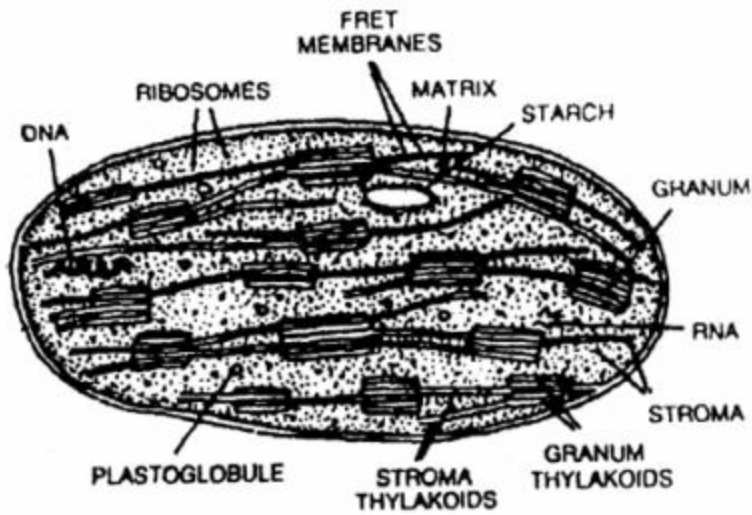
**(iii) Chloroplast :** Contain green pigment, called as chlorophyll.

- Chloroplast was discovered by **Schimper**.
- Number of chloroplasts is variable in different species of plants.
- In lower plants like algae they are 1 or 2 number.
- In higher plants their number varies from 40 -100 per palisade cell or more.
- Chloroplast also have variable shapes, for example cup shaped, ribbon shaped etc. in algae while it is discoidal in higher plants.





**T.S. of leaf**



**Chloroplast**

• A typical structure of chloroplast is a double membranous structure having two parts.

(i) **Grana** : It is a lamellar system consisting of stacks of granum lamella each bounded by a membranous box called as **thylakoid**. They

are 40 - 60 per cell. Number of thylakoids per grana is 50 or more Chlorophyll molecules are found inside the thylakoid membrane where they trap solar energy in the form of small energy packets called '**photon**' or '**quanta**'. Grana are interconnected to each other by a channel called as **stroma lamellae** or **Fret's channel**.

**(ii) Stroma** : It is a non pigmented proteinaceous matrix in which grana remain embedded. It contain enzymes for dark reaction.

### 1.3 (f) Mechanism of Photosynthesis :

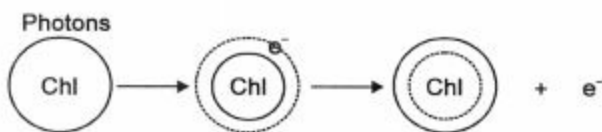
#### (i) Light reaction :

- It is also called as photochemical process.
- It was discovered by <sup>□</sup> '**Robert Hill**' therefore it is also called as

#### **Hill's reaction/**

- **Site** : Grana of chloroplast.
- **Raw materials** : Light and water.
- **Regulation** : This process is regulated by chlorophyll molecules.
- **It consist of 3 steps** :

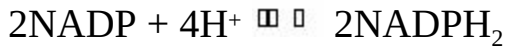
**(A) Photo excitation of chlorophyll molecule** : During this process chlorophyll molecule receives sunlight in the form of small energy bundles called as **photons** and become excited to higher energy level.



**(B) Photolysis** : It is also called as photooxidation of water, this takes place in presence of  $Mn^{+2}$  and  $Cl^-$  ions.



$\text{O}_2$  is liberated as by product and  $\text{H}^+$  ions are used for reduction of NADP



**(C) Photophosphorylation :** During this process ATP are produced. It takes place in **quantasomes**.

$\text{Mg}^{+2}$  ions and inorganic phosphate is required to convert ADP  $\rightarrow$  ATP,  $\text{ADP} + \text{iP} \rightarrow \text{ATP}$ .

**(ii) Dark reaction :**

- It is also called as **thermo chemical reaction**.
- It was discovered by **Melvin calving and benson** therefore it is also called as **Calving cycle** Site = Stroma of chloroplast.
- **Raw materials :** They require  $\text{CO}_2$ ,  $\text{NADPH}_2$ , ATP and Enzymes.
- **Regulated by :** Light reaction and enzymes.
- **It involves three basic steps :**

**(A) Carboxylation :** In this step  $\text{CO}_2$  is captured by  $\text{CO}_2$  acceptors like RUBP (C3 Plants) PET (C4Plants) with the help of **carboxylase enzyme** i.e. RUBISCO & PEPCO respectively.

**(B) Synthesis :** This phase cap true  $\text{CO}_2$  is assimilated into glucose in the presence of phosphatase and isomerease enzymes and RUBP is regenerated back.

**(C) Regeneration of RUBP**

## 1.4 FACTORS AFFECTING PHOTOSYNTHESIS :

### 1.4 (a) Light ;

Normally plants utilize sunlight but marine algae can perform photosynthesis even in the moon light. Plants can also perform photosynthesis in the artificial lights.

- Highest rate of photosynthesis : Red light
- Minimum photosynthesis : Green light
- Very high light intensity can cause reduction in the rate of photosynthesis by causing
  - (i) Decrease in transpiration rate
  - (ii) Denaturation of chlorophyll molecule

#### **1.4 (b) Temperature :**

Optimum range = 25° C to 30° C

It ranges from 10° - 40° C

In some forms like algae of hot spring □ 60° - 70° is normal

#### **1.4 (c) Carbon dioxide :**

It is the first limiting factor 0.03 - 0.1% is present in the atmosphere concentration of CO<sub>2</sub> □ rate of photosynthesis.

above 0.9% □  $\frac{1}{\text{Rate}}$

between 0.1 to 0.9%, it is constant and it is called as saturation point.

#### **1.4 (d) Oxygen :**

O<sub>2</sub> acts as competitive inhibitor of CO<sub>2</sub>. Over concentration of O<sub>2</sub> stops photosynthesis.

#### **1.4 (e) Chlorophyll :**

Chlorophyll content is directly proportional to rate of photosynthesis. No photosynthesis occurs in etiolated cells, In variegated leaves it occurs only at places where chlorophyll is present.

### **1.5 SIGNIFICANCE OF PHOTOSYNTHESIS :**

Photosynthesis is a boon to the nature and to the human beings. It has

following significance :

- (i) Production of food material
- (ii) Atmospheric control and purification of air.

# DAILY PRACTICE PROBLEMS # 1

## OBJECTIVE QUESTION

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- The raw materials for photosynthesis are  
(A)  $\text{CO}_2$  &  $\text{O}_2$  (B) sunlight and  $\text{CO}_2$  (C) water and chlorophyll (D)  $\text{CO}_2$  and water.
- Most of the photosynthesis (80%) which takes place on this earth is carried out by  
(A) green plants on land (B) algae present in fresh water  
(C) algae found in ocean (D) algae present in ocean and fresh water sources.
- Which of the following has no digestive enzyme?  
(A) Saliva (B) Bile (C) Gastric juice (D) Intestinal juice
- Plants are green in colour because  
(A) they absorb green light only (B) they reflect green light  
(C) they absorb green light but reflect all other lights (D) none of the above are correct.
- Full name of NADP is  
(A) Nicotinamide dinucleotide phosphate (B) Nicotine adenine dinucleotide phosphate  
(C) Nicotinamide adenine dinucleotide phosphate (D) None of the above

6. Wavelength of visible light is  
(A) 200 - 400 nm (B) 400 - 700 nm (C) 700 - 900 nm  
(D) 100 - 200 nm
7. The presence of sugar in onion leaves can be tested with  
(A) iodine (B) copper sulphate solution  
(C) lime water (D) benedict's solution
8. Chemical reaction takes place during dark reaction of photosynthesis is  
(A) photolysis (B) hydrolysis  
(C) carbon dioxide is bonded with RUBP (D) nitrogen fixation
9. Dark reaction and light reaction of photosynthesis takes place in  
(A) stroma and grana of chloroplast respectively (B) grana and stroma of chloroplast respectively  
(C) grana only (D) stroma only
10. CO<sub>2</sub> acceptor during dark reaction of photosynthesis is  
(A) RUBP (B) PEP (C) NADPH (D) ATP

## **SUBJECTIVE QUESTIONS**

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### **VERY SHORT ANSWER TYPE QUESTIONS**

1. Define photosynthesis ?
2. Name the different modes of nutrition and classify them with one example of each ?
3. Name the site of light and dark reaction of photosynthesis ?

### **LONG ANSWER TYPE QUESTIONS**

4. Explain how water and temperature influence the rate of photosynthesis ?
5. Describe the structure and role of chloroplast along with a well labelled diagram ?
6. Describe the mechanism of photosynthesis ?
7. Explain the process of 'Photosynthesis' in plants. List four factor which influence this process and describe how each of them affects the rate of the photosynthesis.

**[Delhi, 2005]**

8. Explain the following aspects of photosynthesis in plants :
  - (i) The role of chlorophyll
  - (ii) Dark reaction
  - (iii) Calvin - Benson Cycle.



# NUTRITION

## 2.1 NUTRITION IN ANIMALS :

- Animals have highly evolved digestive mechanism that includes two basic components :

- **Alimentary canal** : Long, hollow, tubular structure consisting of various organs for digestion.

- **Digestive glands** : They secrete enzymes/hormones which help in digestion.

- **Digestion in animals consist of following steps :**

- **Ingestion** : The process of intake of food.

- **Digestion** : It is the breakdown of large and complex molecules into simpler, smaller and soluble forms.

- **Absorption** : Taking up of the digested food through intestinal wall to blood.

- **Assimilation** : In this process absorbed food is taken by body cells.

- **Egestion** : The process by which undigested matter is expelled out.

- Digestive system is regulated by various hormones secreted by some endocrine glands.

- Alimentary canal was first of all developed in the phylum Platyelminthes but only mouth was present in them.

- Coiled and well developed alimentary canal was developed in annelida till mammals.

## 2.2 NUTRITION IN LOWER ANIMALS :

### 2.2 (a) Nutrition in Amoeba :

It is a unicellular organism living in water.

- Mode of nutrition of **holozoic**.
- The process of obtaining food is the **phagocytosis** (cell eating)
- Steps involved in digestion of amoeba are :

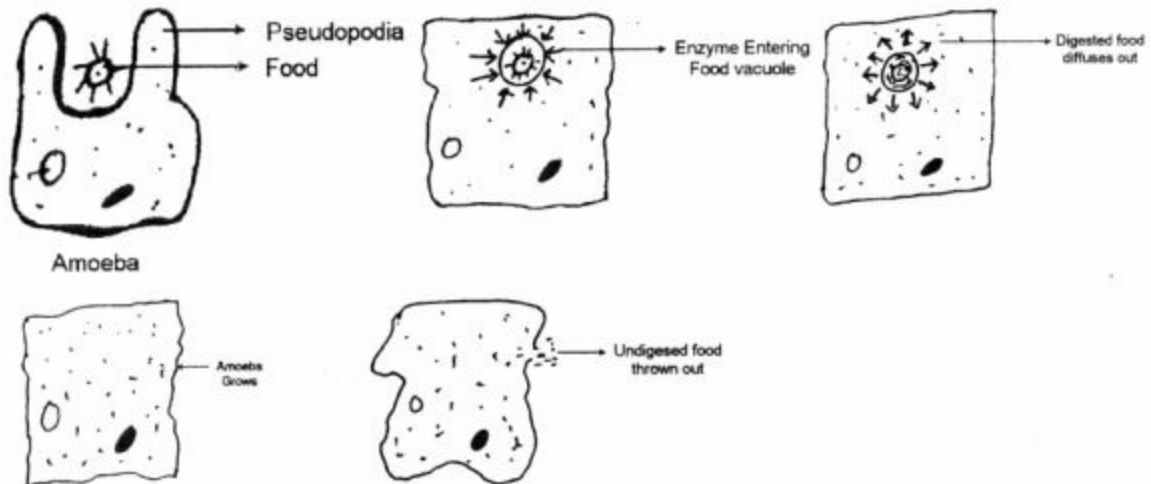
**(i) Ingestion :** Since it is unicellular so a single cell is responsible for carrying out all the vital activities. Food is ingested with the help of **pseudopodia**. Animal engulfs the food particle lying near it by forming pseudopodia around it and forming a **food vacuole** while is considered at its **temporary stomach**.

**(ii) Digestion :** The enzymes from surrounding cytoplasm enter the food vacuole and break down the food into smaller & soluble forms.

**(iii) Absorption :** The digested food is now absorbed by cytoplasm by simple diffusion and then the food vacuole disappear.

**(iv) Assimilation :** The food absorbed in amoeba is used to obtain energy from respiration, for its growth and reproduction.

**(v) Egestion :** Undigested food is thrown out of the cell.



## 2.2 (b) Nutrition in Grasshopper :

- It has a well developed digestive system having an alimentary canal and digestive glands.

- The various organs of digestive system of grasshopper are

Mouth □ Oesophagus □ Crop □ Gizzard □ Stomach □ Ileum □

Colon □ Rectum.

- **Glands associated with it are :**

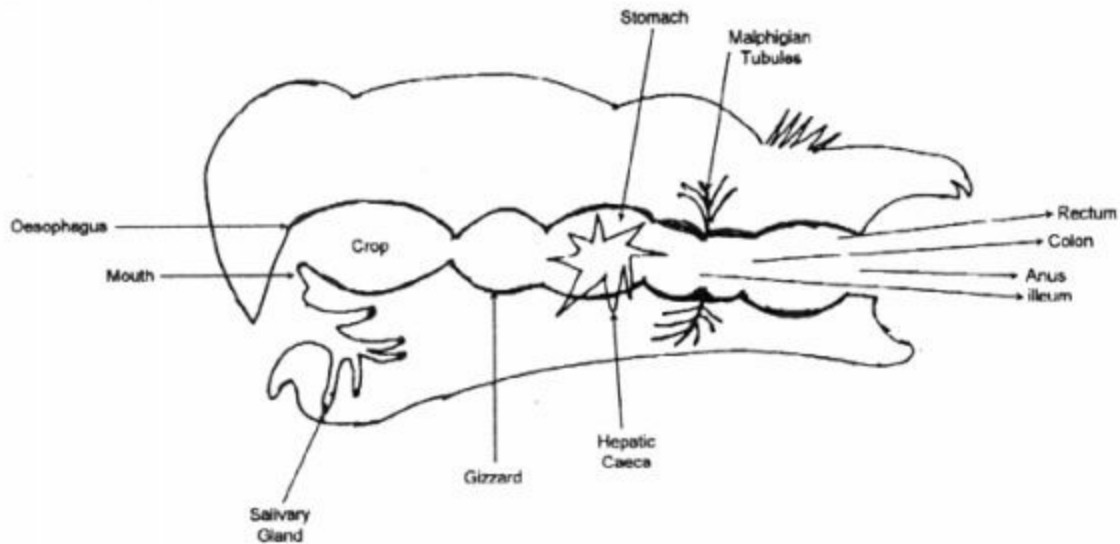
**(i) Salivary glands**    **(ii) Hepatic caeca**

- Digestive system of a grasshopper can be divided into three parts.

**(i) Foregut** : mouth to gizzard

**(ii) Midgut** : gizzard to ileum (actual stomach)

**(iii) Hindgut:** stomach to anus.



• **The process involves:**

**(i) Ingestion :** If feeds on green leaves so it takes food through its mouth with the help of it's forelegs and mouth parts.

**(ii) Digestion:**

**(A)** It starts from the mouth.

**(B)** A pair of salivary glands secretes saliva and release it into the mouth through the salivary duct.

**(C)** Saliva mixed with food and lubricates and soften the food.

**(D)** Digestion of starch begins here.

**(E)** This slightly digested food enters into the crop through a food pipe i.e. esophagus.

**(F)** Crop stores the food temporarily.

**(G)** Now the food moves to gizzard. Here it is finally crushed and masticated an then moves to stomach.

**(H)** In stomach hepatic caeca release its secretions in the form of digestive enzymes, thus the food is then completely digested at this site.

**(iii) Absorption :** The digested food moves to small intestine (ileum) and absorbed through its walls.

**(iv) Assimilation :** Nutrients are assimilated whenever required by the cells for the fulfillment of the growth, energy and repair of the body.

**(v) Egestion :** Undigested food is then passed through hindgut (where  $H_2O$  absorbed) and expelled out through anus in the form of elongated dry faecal pellets.

- The excretory organ of the grasshopper is malphigian tubules present at the junction of hindgut and midgut.

## 2.3 NUTRITION IN HUMANS :

- Humans have highly evolved and complicated digestive system consisting of an alimentary canal and different types of digestive glands.

- Alimentary canal consist of following organs :

### 2.3 (a) Mouth :

It is small slit through which food is ingested.

### 2.3 (b) Buccal Cavity :

Mouth opens into a chamber called as **buccal cavity**. Roof of buccal cavity is called hard palate. At the floor of this cavity thick muscular structure is present called tongue. it helps in chewing swallowing, testing and speaking. Tongue has various types of papilla having **taste buds**.

- Jaws present in buccal cavity are provided with four different types of teeth :

- |              |   |             |
|--------------|---|-------------|
| (i) Incisors | : | For cutting |
| (ii) Canines | : | For tearing |

(iii) Premolars : For grinding

(iv) Molars : For grinding

• **Dental formula of humans :**

(A) Milk teeth □ These are temporary, arise at 6 - 11 month age, 20 in number

$$\frac{\text{Half upper jaw} \quad \square \quad 2102}{\text{Half lower jaw} \quad \square \quad 2102}$$

(B) Permanent teeth □ arise at 6 – 12 years, 32 in number

$$\frac{\text{Half upper jaw} \quad \square \quad 2123}{\text{Half lower jaw} \quad \square \quad 2123}$$

• Three pairs of salivary glands are found in mouth which release their secretions into the buccal cavity.

### 2.3 (C) Oesophagus :

Also called as food pipe. It leads the food from mouth to stomach, Oesophagus has highly muscular walls, no digestion occurs here.

### 2.3 (b) Stomach :

It is a 'J' shaped bag present on left side of abdomen. It contains several branched and butular glands present on the inner surface of its wall, which secret gastric juice.

### 23 (e) Small Intestine :

It is a coiled and narrow tube having 3 regions : Duodenum , jejunum, ileum.

• On the inner wall of small intestine numerous finger like projections are found which are called as **villi**, they increase the surface area of absorption.

• Duodenum is proximal part of small intestine receives secretion from liver and pancreas.

### 2.3 (f) large Intestine :

Small intestine opens into large intestine from w here the undigested

food material is passed to anus through rectum. It is divided into three parts:

**(i) Caecum      (ii) Colon      (iii) Rectum**

### **2.3 (g) Digestive Glands :**

**(i) Salivary glands :** 3 pairs of salivary glands are found in mouth cavity. It helps in chemical digestion. They secrete an enzyme called **salivary amylase** or **ptyalin**. It helps in digestion of starch.

**(ii) Gastric glands :** Present in stomach. They secrete hydrochloric acid, protein digesting enzymes and mucus.

**(iii) Liver :** It is the largest gland, secretes bile into the small intestine. Bile contains bile juice and bile pigments. Bile is alkaline in nature and it is temporarily stored in gall bladder and helps in digestion of fats, it also helps in absorption of fats.

**(iv) Pancreas:** It lies parallel to and below the stomach. It secretes pancreatic juice into small intestine. Pancreatic juice contains trypsin and pancreatic amylase. Besides these 2 enzymes pancreas secretes 2 hormones also i.e. :- insulin and glucagons so it has both exocrine as well as endocrine functions. Both bile and pancreatic juice are released into the duodenum by a common duct.

## DAILY PRACTICE PROBLEMS # 2

### OBJECTIVE QUESTIONS

1. Compensation point refers to the intensity of light at which  
(A) Rate of respiration = rate of photosynthesis (B) Rate of respiration > rate of photosynthesis  
(C) Rate of respiration < Rate of photosynthesis (D) None of the above is correct
2. Among the following which is a parasitic plant ?  
(A) Plasmodium (B) Cuscuta (C) Amoeba (D) Rhizobium
3. The nutrition in mucor is  
(A) parasitic (B) autotrophic (C) saprophytic (D) holozoic
4. In amoeba the digestion is intracellular because  
(A) amoeba is unicellular (B) amoeba is multicellular  
(C) amoeba is found in pond (D) amoeba is microscopic animal
5. Digestion of food in human starts from  
(A) duodenum (B) small intestine (C) mouth (D) large intestine
6. The digestion of food is completed in the  
(A) ileum (B) duodenum (C) stomach (D) large intestine
7. The most important function of villi in the small intestine is  
(A) to provide strength to the intestine  
(B) to provide space for capillaries and lacteals  
(C) to provide increased surface area for absorption of digested food  
(D) to provide habitat for bacteria
8. Which of the following sections does not contain enzymes ?  
(A) Bile (B) Pancreatic juice (C) Intestinal juice (D) Saliva



9. Chewing is an example of  
(A) chemical digestion (B) mechanical digestion (C) involuntary action (D) hydrolysis
10. The final product of digestion of carbohydrates and proteins are  
(A) glycerol and amino acid respectively (B) glucose and amino acids respectively  
(C) amino acids and glycerol respectively (D) amino acids and glucose respectively

## **SUBJECTIVE QUESTIONS**

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### **VERY SHORT ANSWER TYPE QUESTIONS**

1. Name the different steps involved in digestive process.
2. Name the excretory organ of grasshopper.
3. Give the importance of bile during digestion process, also write from where it is secreted, what is its site of action ?

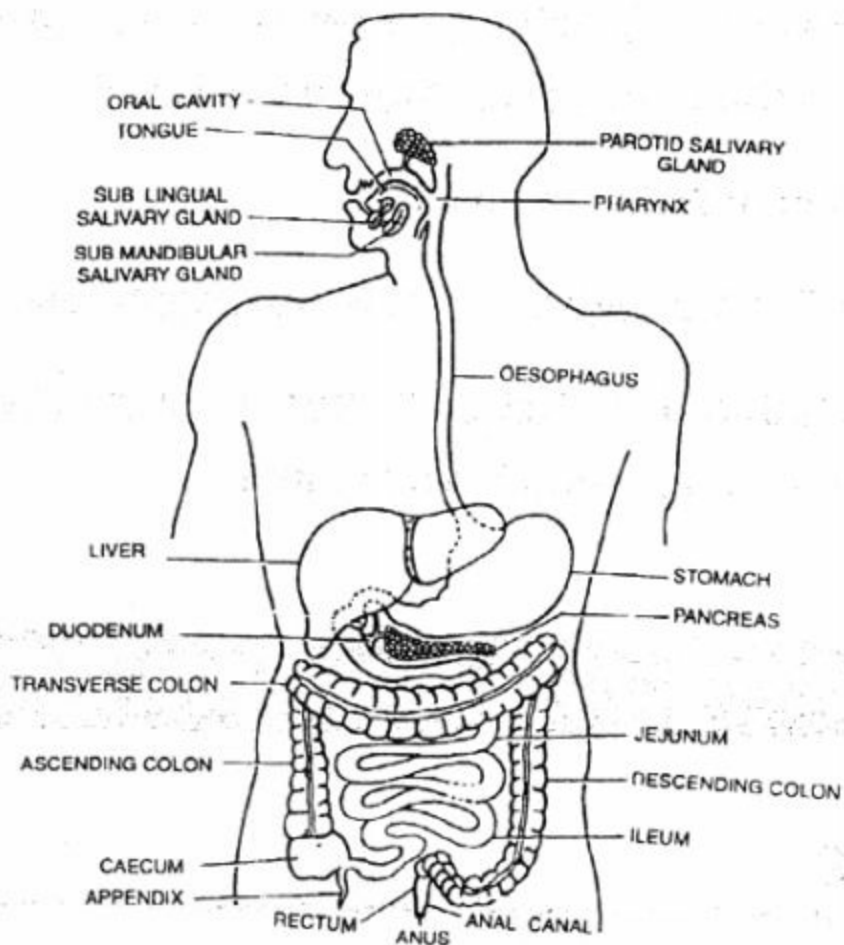
### **LONG ANSWER TYPE QUESTIONS**

4. Draw a well labelled diagram of human alimentary canal. Mention the functions of liver in digestion.
5. Describe the digestive system of grasshopper with the help of a well labelled diagram ?
6. Explain how does the major nutrients in chapatti eaten by you in your food get digested and finally absorbed by the alimentary canal ?

# NUTRITION

## 3.1 INTESTINAL GLANDS :

They secrete intestinal juice and mucus.



### 3.1 (a) Digestive System :

This system involves following processes :

(i) **Ingestion** : Intake of food is done through mouth, food is then

chewed and masticated and sent to esophagus through pharynx by swallowing.

**(ii) Digestion :** Saliva secreted in buccal cavity starts digestion of starch into maltose. This partly digested food is then passed to stomach by esophagus through peristaltic movement. Food is churned in stomach for about three hours and broken down into smaller pieces. Due to presence of hydrochloric acid, medium of stomach becomes acidic. In acidic medium protein digestive enzyme pepsin breaks down proteins into peptones. Gastric Lipase is also secreted here which partially breaks down lipids.

- Secretion of gastric juice is stimulated by the sight, smell or thought of food.
- Now the partly digested food moves to small intestine i.e. in the duodenum. Duodenum receives the secretion from liver and pancreas through a common duct they are bile and pancreatic juice, and alkaline in nature. So the digestion and emulsification of fats occurs at this place.
- Here in the duodenum fats are emulsified by bile, remaining proteins are digested by trypsin and starch by pancreatic amylase.

**NOTE :** Duodenal wall secretes bicarbonate ions which make the medium alkaline.

- This partially digested food now enters in the ileum where intestinal juice i.e. **“Succus entericus”** is secreted. At this place digestion is completed.

Carbohydrates → Glucose

Proteins → Amino acids

Fats → Fatty acids and glycerol

**(iii) Absorption :** After digestion molecules are broken down into

simpler water soluble forms now they are to be utilized, so they pass through the wall of small intestine which contains blood capillaries and enters into the blood. For absorption of fat lymph capillaries are present called as lacteals.

**NOTE :** Wall of small intestine have tiny finger like projections called **villi**, they increase the surface area for absorption.

**(iv) Assimilation :** The process of utilizations of food is called assimilating. The nutrients dissolved in blood are carried to all parts of the body where they are utilized.

**(A) For** building up and replacement of cells.

**(B)** For obtaining energy. This energy is released by the process of oxidation during respiration.

**(v) Egestion :** The undigested food is then collected in large intestine where water is absorbed and remaining waste is expelled out or egested through anus.

## DAILY PRACTICE PROBLEMS # 3

### OBJECTIVE QUESTIONS

- In amoeba the digestion of food is  
(A) extracellular (B) intracellular (C) intercellular (D) none of the above
- Through mastication of food is essential because  
(A) mastication of food makes the teeth stronger  
(B) it makes the process of swallowing the food easier  
(C) by this process bigger pieces of food are broken down into smaller pieces.  
(D) bigger pieces of food are broken down into smaller pieces and saliva is properly mixed with it
- The wave of contractions that pushes the food through the alimentary canal is called  
(A) peritoneum (B) peristalsis (C) cyclosis (D) polarisation
- In amoeba absorption of the digested nutrients occurs in  
(A) contractile vacuole (B) plasma membrane (C) cytoplasm (D) pseudopodia
- Coiled and well developed alimentary canal first developed in  
(A) Protozoans (B) Mammals (C) Arthropods (D) Poriferans
- Digestion of starch starts from  
(A) stomach (B) intestine (C) esophagus (D) mouth
- The path taken by food material after ingestion is represented by

- (A) Mouth □ Pharynx □ Oesophagus □ Stomach  
 (B) Mouth □ Pharynx □ Oesophagus □ Small Intestine  
 (C) Mouth □ Oesophagus □ Stomach □ Pharynx  
 (D) Oesophagus □ Mouth □ Pharynx □ Stomach
8. Teeth involved in cutting of food material are called  
 (A) canines (B) incisors (C) molars (D) premolars
9. Ptyalin enzyme is secreted by  
 (A) salivary glands (B) mouth (C) esophagus (D) stomach
10. Villi are present on  
 (A) stomach (B) large intestine (C) small intestine (D) mouth

---

## SUBJECTIVE QUESTIONS

### VERY SHORT ANSWER TYPE QUESTION

1. What is the product formed during  $C_3$  cycle of dark reaction of photosynthesis ?
2. Where does the absorption of food takes place ?
3. Name five different types of glands involved in human digestive system

### LONG ANSWER TYPE QUESTIONS

4. Explain various digestive glands present in man along with their secretions & functions.
5. Explain dark reaction of Photosynthesis.
6. What is photophosphorylation ? Explain cyclic and monocyclic photophosphorylation in brief.



<b>Ans.</b>	<b>A</b>	<b>B</b>	<b>C</b>	<b>A</b>	<b>C</b>	<b>A</b>	<b>C</b>	<b>A</b>	<b>B</b>	<b>B</b>
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### **DAILY PRACTICE PROBLEMS # 3**

<b>Qus.</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>	<b>9</b>	<b>10</b>
<b>Ans.</b>	<b>B</b>	<b>D</b>	<b>B</b>	<b>A</b>	<b>C</b>	<b>D</b>	<b>A</b>	<b>B</b>	<b>A</b>	<b>C</b>



# TRANSPORTATION

---

## 4.1 INTRODUCTION :

All living bodies need nutrients and oxygen in every cell of its various tissues to sustain life. The transport of different material and gases is essential both in plants and animals. Unicellular organisms e.g. Amoeba and Paramecium do not require the transport of any material. These are in direct contact with their surroundings from where they obtain these nutrients. These substances are distributed in the cytoplasm due to the streaming movements of cytoplasm called as **cyclosis**. **They** exchange gases from the external environment directly by diffusion due to the difference in the concentration in and outside their body. In higher organisms both plants and animals, digested food, oxygen, hormones, waste nitrogenous substances etc. are to be carried from one place to the other. So transportation of materials is essential. It is done through circulatory system.

### 4.1 (a) Transportation in Higher Plants :

The higher plants have specialized system for the transportation of materials inside the body. The transportation of material is carried out by means of vascular tissues of the plants. The vascular tissues act as pipes or vessels. Through these vessels or pipes, water, minerals, salts, food etc. are transported in the plant body. In plants the medium of transportation is water. Water and food flows through the xylem (tracheids and vessels are the constituents of xylem) and phloem (sieve tubes and companion cells) for various metabolic activities. Tracheids and vessels are nonliving parts of xylem while sieve tubes and companion cells from the living parts of phloem. The terrestrial (land)

plants absorb water and mineral salts through their roots. The area of young roots where most of the absorption takes place is the root hair zone. Root **hair are the extensions of the epidermal cells**. Root hair are delicate and do not live more than two days. The root hair have sticky walls by which they adhere tightly to soil particles. The root hair absorb water from soil by the process of osmosis but take in mineral salts by diffusion. The water and mineral salts are transported from the roots to the leaves, flowers and other parts of the plant. The upward movement of cell sap (water and minerals) through the xylem is called “**ascent of sap**”.

#### **4.1 (b) Translocation :**

Phloem Translocates the manufactured food (sugar) or starch from the leaves to the leaves to the different parts of the plant including the roots.

#### **4.1 (c) Transpiration :**

Most of the water absorbed is lost through the aerial parts of the plant into air by a process called “**transpiration**”. **Two** percent of total water absorbed is used up in various metabolic activities in the plant body. Transpiration is the loss of water from the living tissues of the aerial parts of the plant in the form of water vapours. There are three types of transpiration :

- (i) Cuticular transpiration** (through cuticle)
- (ii) Lenticular transpiration** (through lenticels)
- (iii) Stomatal transpiration** (through stomata)

##### **• Importance of transpiration :**

- (A)** It controls the rate of absorption of water from the soil.
- (B)** It is responsible for ascent of sap.
- (C)** It regulates the temperature of the plant.
- (D)** Mostly water absorbed by roots is lost by transpiration without serving any purpose.

The energy spent by the plants in transpiration is wasted. So transpiration is a necessary evil.

#### **4.1 (d) Differences in Function of Xylem and Phloem :**

<b>Xylem</b>	<b>Phloem</b>
--------------	---------------

- |  |   |
|--|---|
| <p>(i) Functional xylem cells are dead.<br/>phloem cells are alive.</p> <p>(ii) It carries mineral salts, water and solution of sugars and amino acids is traces of organic molecules</p> <p>(iii) The movement is only upward.<br/>can be upward or downward.</p> | <p>(i) Functional phloem cells are alive.</p> <p>(ii) An organic solution of sugars and amino acids is translocated.</p> <p>(iii) The movement can be upward or downward.</p> |
|--|---|

## 4.2 TRANSPIRATION COHENSION THEORY :

The main loss of water is through stomatal transpiration. Turgor pressure in the mesophyll cells of the leaf forces water outwards through the cell wall. Water evaporates from the surface of the cells into the air spaces of the spongy tissues and then passes into the outer atmosphere through the pores or stomata. The cell sap of mesophyll cells becomes concentrated by losing water and causes a drop in turgor pressure. As a result water is sucked from adjoining mesophyll cells and ultimately from vascular tissues. This tension is transmitted all the way down to the unbroken column of water through the stem to the absorbing parts of the root. The molecules of the water show cohesion (mutual attraction) and molecules of water and vessel wall show adhesion (affinity for water). Due to these adhesive and cohesive forces, water column does not break but pulled upward by the force called as **“transpiration pull”**. The whole process can be compared with a person (transpiration pull) pulling a bucket full of water (forces on water column) from a well with a rope (column of water due to cohesion).

## 4.3 TRANSPORTATION IN HUMANS :

In humans there is a circulatory system that uses blood or lymph as carriers of materials (fluid exchange medium) and the heart as the pumping organ to help in circulation. Circulatory system consists of blood vascular system (blood as carrier) and lymphatic system (lymph

as carrier).

#### 4.3 (a) Blood Vascular System :

The higher multicellular animals with higher metabolic rates possess a well developed blood vascular system. This system helps in the quicker supply of nutrients and oxygen to the body tissues and also in the rapid disposal of toxic waste material and carbon dioxide. The blood acts as the circulatory fluid. Blood vascular system consists of blood, blood vessels and heart.

**(i) Blood :** The blood is a specialized kind of living connective tissue which is made to circulate, by the muscular pumping organ called as **the heart**. In adult human beings there is 5.5 to 6 liter of blood. The blood consists of fluid part, the plasma. The red blood corpuscles (RBCs), white blood corpuscles (WBCs) and blood platelets are present in the plasma. The formation of blood is called “**Hemopoiesis**”.

**(ii) Plasma :** The plasma consists of water (90% & above) inorganic substances. In the plasma RBCs, WBCs and blood platelets float. Inorganic salts (09%) are also present. The organic substances are glucose, amino acids, proteins, hormones, digested and waste excretory products. The blood proteins (7%) are **fibrinogen, albumin, globulin and prothrombin**.

**NOTE :** Serum is plasma from which fibrinogen is removed.

**(A) Red Blood Corpuscles (RBCs) or Erythrocytes :** The number of RBCs is about 5.5 million in 1 ml of blood. The total number of RBC is about 30 billion. Each RBC is a **biconcave disc-like structure devoid of nucleus**. The mammalian erythrocytes do not possess nuclei, mitochondria and endoplasmic reticulum. The erythrocytes contain hemoglobin. Hemoglobin consists of globin (protein) and  $Fe^{2+}$  porphyrin complex (haeme). 100 ml of blood contains 15 mg of hemoglobin. If the amount of hemoglobin in blood is less, the person suffers from anemia. The hemoglobin carries oxygen to the different cells of the body and brings carbon dioxide from the cells. The life span of a RBC is 120 days.

**(B) White Blood Corpuscles (WBCs) or Leucocytes :** The number of

leucocytes is comparatively fewer i.e. one ml of blood contains 5000 - 10000 leucocytes in humans. The total number of WBCs is about 75 millions. The number of leucocytes increases in infections like **pneumonia, blood cancer** (Leukemia) etc. These are large in size and contain nucleus. White blood corpuscles are of two types :

- **Granulocytes** : In granulocytes the cytoplasm contains granules and the nucleus is multilobed. Basophils, Eosinophils and Neutrophils are three different types of granulocytes. **Eosinophils** and **neutrophils** are phagocytic (engulf and kill harmful microbes ) in nature and this process is called as “**phagocytosis**”. The function of **basophils** is to release histamine and Heparin.

- **Agranulocytes** : Monocytes and lymphocytes are two different types of agranulocytes. **Lymphocytes** secrete antibodies which destroy microbes. The **monocytes** are phagocytic in nature.

**(C) Blood platelets** : These are small and without nuclei. Their number varies from 0.15 to 0.45 million in 1ml of blood. Their normal life span is one week. These help in blood clotting at the site of injury by liberating **thromboplastin**.

#### 4.3 (b) Functions of Blood :

Blood performs the following functions :

- **Transpiration of nutrients** : The digested and absorbed nutrients like glucose, amino acids, fatty acids are first transported to the liver and then to all the tissues for their storage, oxidation and synthesis of new substance.

- **Transportation of respiratory gases** : The respiratory gases (oxygen, carbon-dioxide) are transported by the blood. Oxygen is transported from the respiratory surface (lung, skin and buccal cavity) to the tissues and carbon dioxide from the tissues is taken to the respiratory organ for its removal.

- **Transportation of excretory products** : Different wastes from the different parts of the body are collected by the blood and then taken to the organs (kidneys, lungs, skin and intestine) from where they are excreted.

- **Transportation of hormones** : Hormones are produced by endocrine glands. These hormones have target organs (place to act). These are carried by the plasma of blood and bring about the coordination in the working of the body.
- **Maintenance of pH** : the plasma proteins act as buffer system and maintains required pH of the body tissues.
- **Regulation of body temperature** : The blood flows in all the parts of body, so it equalizes the body temperature. It carries heat from one place to another place in the body.
- **Transportation of metabolic intermediates** : The blood carries metabolic intermediates from one tissue to another for further metabolism. In the muscle cells due to anaerobic respiration lactic acid is produced. This lactic acid is carried to the liver for further oxidation.
- **Water balance** : The blood maintains water balance to constant level by distributing it uniformly in the body.
- **Protection from diseases** : The WBCs (eosinophils, neutrophils, monocytes) engulf the bacteria and other disease causing organisms by phagocytosis. The lymphocytes produce antibodies to neutralize the action of toxins produced by pathogens.
- **Clotting of blood** : Blood forms a clot at the site of injury and thus prevents the further loss of blood.
- **Support** : Blood flows under pressure in arteries. Due to this tissues become stiff as in the case of erection of nipples, clitoris and penis.

#### 4.3 (c) Blood Clotting :

At the site of injury of the blood vessels, the platelets induce blood coagulation through the release of **thromboplastin** (thrombokinase). Thromboplastin changes prothrombin of blood plasma into thrombin. Thrombin converts soluble protein fibrinogen to insoluble fibrin. Fibrin forms a network which entangles RBCs and blood platelets to form plug or **clot** over the injured area. Blood clotting is usually completed within 2-3 minutes.

Injured tissue + Blood platelets

Thromboplastin released

**Prothrombin**

**Thrombin**

**Fibrinogen**

**Fibrin**

**(soluble)**

**(Insoluble )**

Fibrin +Red blood corpuscles

Clot of blood

#### **4.3 (d) Blood Groups :**

**Land Steiner** discovered that blood of different individual did not match each other but there were biochemical differences. He discovered Antigens A and B and blood groups (**ABO systems**). Antigen (agglutinogen) is a glycoprotein present on RBCs. For each antigen there is a corresponding antibody. Thus there are two antibodies (agglutinin) a and b occurring in the blood plasma. There are four types of blood groups depending on the presence or absence of these antigens.

<b>Body Group</b>	<b>Antigen present on RBCs</b>	<b>Antbody in plasma</b>
<b>A</b>	<b>A</b>	<b>b</b>
<b>B</b>	<b>B</b>	<b>a</b>
<b>AB</b>	<b>AB</b>	<b>None</b>
<b>O</b>	<b>None</b>	<b>a,b,</b>

Blood is a life saving fluid. It is often needed during accident and operation. The transfusion of blood is only done when blood group is known. These groups are A,B,AB and O. Blood of O group is a universal donor i.e. it can donate blood to any group (A, AB, B and O) but it can receive blood from O blood group. A B group is universal recipient (receiver). It can receive blood from any group (A, B, AB, O) but it can donate to AB group only.

### 4.3 (e) Blood Transfusion :

The transfusion of blood from a healthy person to a patient suffering from blood loss due to injury or surgical operation is called a “**blood transfusion**”. For this all major hospitals have **blood banks** where blood is collected from voluntary and professional donors. Before preservation the blood is tested for its blood group and Rh factor. Though theoretically a patient may be able to receive blood of two or more types, it is always advisable to have the donor blood of the same group as that of the recipient. Rather the blood of donor is always crossmatched before transfusion to exclude any change of incompatibility. When blood from a donor is added to blood of the recipient, it is necessary to avoid bringing together corresponding antigen and antibody. This causes clumping of RBCs. Thus antigen A in RBCs of group A individuals reacts with antibodies of plasma of group B individuals. This phenomenon is called “**agglutination**”.

**Table Human blood groups and transfusion**

Blood group of donor	Blood group of recipient			
	O	A	B	AB
O	→	→	→	→
A	x	→	X	→
B	x	X	→	→
AB	x	X	x	→

→ Compatible

x Incompatible

Rh factor (in blood) can be genetically determined. Most of the people



(more than 85%) are Rh positive (Rh<sup>+</sup>) while a few are Rh negative (Rh<sup>-</sup>). Both people lead normal life. If an Rh<sup>-</sup> woman marries with an Rh<sup>+</sup> man then Its pregnancy is normal but in 2nd pregnancy the mother with Rh<sup>-</sup> blood may lose the baby due to incompatibility of Rh factor. By new techniques and procedures now the child can be saved.

## DAILY PRACTICE PROBLEMS # 4

### OBJECTIVE QUESTIONS

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1. Osmosis is the movement of :  
(A) solute particles from higher concentration to lower concentration  
(B) solvent particles from higher water potential to lower water potential through a semi permeable membrane  
(C) solute particles from higher concentration to lower concentration through a semipermeable membrane  
(D) solvent particles from lower water potential to higher water potential.
2. The ultimate cause for the movement of water against the gravity in a tree is  
(A) osmosis (B) transpiration (C) imbibitions (D) photosynthesis
3. Which one of the following is connected with transport of water in plants ?  
(A) Phloem (B) Xylem (C) Epidermis (D) Cambium
4. Which of the following contributes most to transport of water from the ground to the leaves of a tall tree ?  
(A) Breakdown of ATP (B) Capillary rise of water in xylem  
(C) Cohesion of water and transpiration pull (D) Root pressure.
5. The process of transpiration in plants helps in  
(A) opening of stomata (B) absorption of CO<sub>2</sub> from

atmosphere

(C) upward conduction of water and minerals (D) absorption of  $O_2$  from atmosphere

**6.** Opening and closing of stomata is due to

(A) pressure of gases inside the leaves (B) changes of turgor pressure in guard cells

(C) effect of hormones (D) their genetic constitution

**7.** The carbohydrates synthesized in the leaves are transported through sieve tubes most commonly in the form of

(A) glucose (B) starch (C) sucrose (D) cellulose

**8.** In a closed circulatory system, blood is completely enclosed with in

(A) sinuses (B) vessels (C) heart (D) skeleton

**9.** An artery is a vessel that carries blood

(A) with high concentration of oxygen (B) with high concentration of  $CO_2$

(C) away from the heart (D) both A & C

**10.** Values are found in veins to check the backflow of blood flowing under

(A) low pressure (B) high pressure (C) no pressure (D) atmospheric pressure.

## **SUBJECTIVE QUESTIONS**

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### **FILL IN THE BLANKS :**

(i) ..... is the flow of water molecules from the region of higher water potential to the region of lower water potential through a semipermeable membrane.

(ii) The osmotic entry of water into a cell is called .....

(iii) Other name for blood platelets is .....

(iv) The process of production of erythrocytes is known as .....

(v) Heart is protected by a covering known as .....

### **VERY SHORT ANSWER TYPE QUESTIONS**

1. Explain the importance of transportation.
2. Distinguish between diffusion and osmosis.
3. How does blood clot ?

### **LONG ANSWER TYPE QUESTIONS**

4. Explain the composition of blood. Also give functions of all its components.
5. Explain various components of xylem and phloem.
6. Comment upon :
  - (i) Translocation in plants
  - (ii) Xylem
  - (iii) Phloem
  - (iv) Excretion in plants
7. What is clotting of blood' ? Write a flow chart showing major events

taking place in clotting of blood.

**[CBSE, Delhi 2005]**

**8.** Name the constituents of blood. Why are white blood corpuscles called 'soldiers of the body' ?

**[CBSE, Delhi 2005]**

**9.** Draw a diagram of human heart and label the following on it  
**[CBSE, Delhi 2005]**

(i) Aorta                      (ii) Pulmonary trunk                      (iii) Superior vena cava  
(iv) Coronary arteries

**10. (a)** List any four blood groups found in human beings.

**[CBSE, 2005]**

**(b)** People of which blood group can

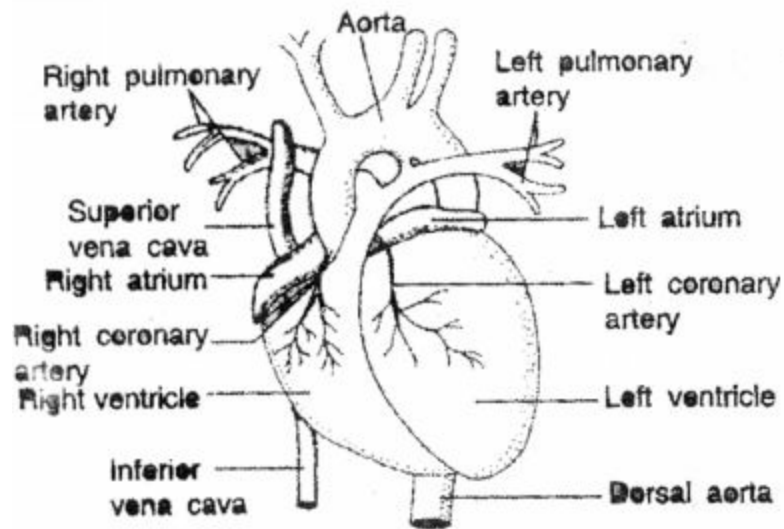
**(i)** donate blood to all groups ?                      **(ii)** receive blood from all groups ?

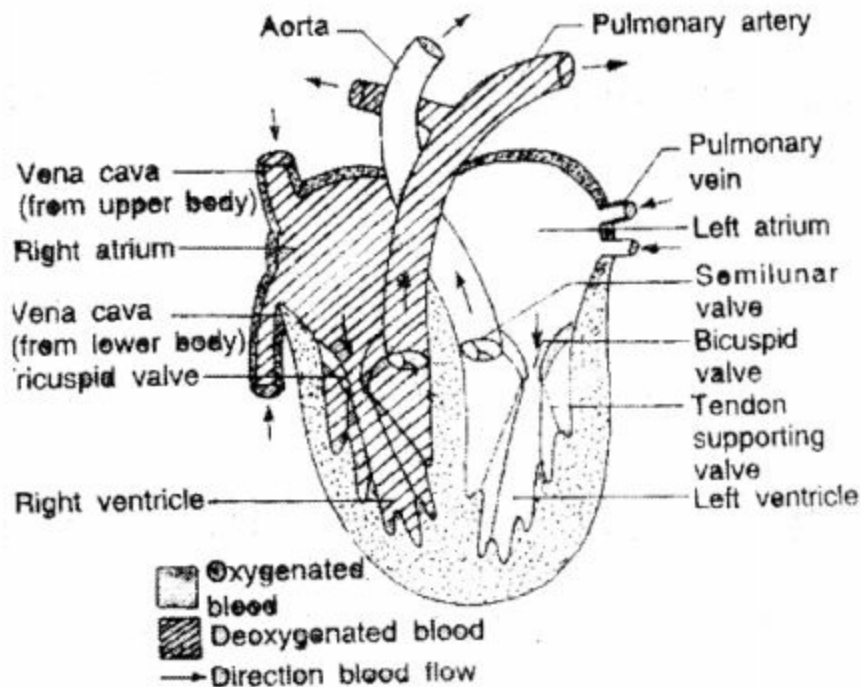
**11.** List two vital functions of the human kidney. Draw a labelled diagram of an artificial kidney

**[CBSE, 2005]**

# TRANSPORTATION

## 5.1 STRUCTURE OF HEART





- Heart is a hollow muscular organ that lies obliquely in the thoracic region in a cavity between the two lungs that is **pericardial cavity**. It is lined by 2 layers outer and inner pericardial membranes. These are filled with a fluid called **“pericardial fluid”**. It protects the heart from shock and injury.

- Heart is made up of 4 chambers : upper 2 chambers are auricles and the lower 2 chambers are ventricles. Auricles are the receiving chambers and ventricles are the pumping chambers. Walls of ventricles are thicker as they have to pump the blood.

- Partition between right and left auricle is called **“interauricular septum”** and between right and left ventricles is **“inter ventricular septum”**.

- Four pulmonary veins enter into left auricle, two from each lung bring oxygenated blood. There is one auriculoventricular aperture with a bicuspid or mitral valve in left auricles which opens

into left ventricle.

- Left ventricle has aortic valve having 3 semilunar cusps for large artery i.e. dorsal aorta which takes the oxygenated blood to all body parts.

- Right auricle has openings for superior venacava that brings deoxygenated blood from head, neck and upper limbs, inferior venacava receives deoxygenated blood from rest of the body and lower limbs. Blood enters into right ventricle through tricuspid valve. A coronary sinus that drains venous blood from heart muscles.

- Right ventricle has pulmonary valve having 3 semilunar cusps for pulmonary artery carrying deoxygenated blood to lungs.

- The series of events which occur during one heart beat is called as cardiac cycle.

- **NOTE** : During foetal condition a flap valve called “**foramen ovale**” is present at interauricular septum having a depression called as **fossa ovalis**. If it remains after birth it results “a hole in the heart”.

### **5.1 (a) Blood Pressure :**

It is the pressure of the flow of blood in the aorta and its main arteries. The blood pressure varies according to the contraction and relaxation of the heart. In the condition of contraction or systolic phase (Lubb sound) it is about 120 mm of Hg. This is called “**systolic pressure**”. In the relaxation or diastolic phase (Dub sound) it is about 80 mm of Hg and is called “**diastolic pressure**”. The normal blood pressure of man (20 years) is 120/80. Fats and anxiety increase the blood pressure, the maximum normal blood pressure should not exceed 150 in males and 140 in females. The blood pressure is measured by “**sphygmomanometer**”.

### **5.1 (b) Detection of Normalcy of Heart Beat :**



The muscle fibres of heart are specialized at certain parts generate tiny electrical currents which cause the normal heart beats. The **“electrocardiograph” (E.C.G.)** is the device to record these electrical changes. Electrocardiogram is a record of electrical behaviour of heart and remains constant in a normal man. Doctors use the E.C.G. for detection of various heart diseases. Sometimes the sinoatrial node (SA node or pacemaker) gets damaged and fails to generate cardiac impulses at normal rate it becomes abnormally slow and irregular and ventricles fail to pump the required amount of blood. It can be corrected by the surgical grafting of an **artificial pacemaker instrument** in the chest of the patient. This instrument stimulates the heart electrically at regular intervals to maintain the beats.

## 5.2 LYMPHATIC SYSTEM :

The lymphatic system comprises the lymph, lymphatic capillaries (simply lymphatic), lymphatic vessels and nodes. Lymph serves as the middle man between the blood and organ for exchange of any material. The lymph is the tissue fluid present in the intercellular spaces in the tissues. So it is also called as **“extracellular fluid”**. The lymph resembles the blood except that the lymph is devoid of R.B.Cs, blood platelets and some plasma proteins. Lymphatic system runs parallel to the veins. The **lymphatic capillaries** are present in the form of network under epithelial surface. The ends of lymphatic capillaries are blind. The lymphatic capillaries unite to form lymphatic vessels and these vessels resemble with the veins. The lymphatic vessels possess the valves which prevent back flow of lymph. Neighboring body muscles help in the flow of lymph. The small lymphatic vessels unite to form large vessels. Larger lymphatic vessels unite to form large ducts i.e. **right lymphatic duct** and **thoracic duct**. Right lymphatic duct opens into right subclavian vein and left thoracic duct opens into left subclavian vein. Before the lymph reaches the blood, it always passes through the **lymph nodes**. The lymph's nodes are enlargements of the lymphatic vessels. Lymphocytes and other plasma cells are present in

the lymph nodes. The lymph is cleaned or filtered by lymph nodes. These cells also kill the germs and produce antibodies.

### **5.2(a) Functions of Lymph :**

- (i) It provides immunity through lymphocytes.
- (ii) Fats are absorbed through lymph vessels in the intestine
- (iii) It supplies digested food and oxygen to various parts of the body.
- (iv) It helps in removal of waste products like parts of dead cells.
- (v) It returns proteins and excess tissue fluid to the blood from the tissue spaces.

## DAILY PRACTICE PROBLEMS # 5

### OBJECTIVE QUESTIONS

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1. The phenomena non of uptake of water at the expense of energy by the cells and usually against the osmotic gradient is known as  
(A) active absorption (B) passive absorption (C) osmosis (D) diffusion
2. Water will be absorbed by root hair when  
(A) concentration of solutes in the cells sap in high  
(B) plant in rapidly respiring  
(C) they are separated from soil by a permeable membrane  
(D) concentration of salts in the soil in high.
3. Root cap has no role in water absorption because  
(A) it has no direct connection with the vascular system  
(B) it has no cells containing chloroplasts  
(C) it has no root hairs  
(D) it has loosely arranged cells.
4. Which of the following is used in measuring transpiration ?  
(A) Photometer (B) Cobalt chloride paper (C) Bell - jar (D) None of the above
5. Translocation of solutes primarily takes place through  
(A) phloem (B) xylem (C) cortex (D) pith.
6. A mature human erythrocyte has the typical characteristic of  
(A) a eukaryotic cell (B) a prokaryotic cell  
(C) both eukaryotic and prokaryotic cell (D) neither eukaryotic nor prokaryotic cell
7. Removal of calcium from freshly collected blood will  
(A) result in clotting (B) prevent clotting  
(C) prevent oxidation of hemoglobin (D) cause hemolysis
8. In the cardiac cycle, diastole is

- (A) the number of heart beats per minute
- (B) the relaxation period after contraction of the heart
- (C) the forceful pumping action of the heart
- (D) the contraction period after relaxation of the heart.

**9.** One of the difference between blood and lymph is that

- (A) blood has RBCs and WBCs while lymph has Lymphocytes.
- (B) blood has RBCs while lymph has no WBCs
- (C) blood has WBCs while lymph has RBCs

(D) blood has dissolved organic salts while lymph has no such inorganic salt.

**10.** Blood vessel carrying blood from lung to heart through

- (A) Pulmonary artery
- (B) Pulmonary vein
- (C) Coronary artery
- (D) None of these.

## **SUBJECTIVE QUESTIONS**

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### **FILL IN THE BLANKS**

1. The series of events which occur during one complete beat of the heart is known as ..... cycle.
2. Depression in the interauricular septum is known as .....
3. Normal blood pressure is .....

### **VERT SGIRT ANSWER TYPE QUESTIONS**

1. Write short note on leucocytes.
2. Distinguish between open and closed circulatory system.
3. What is double circulation ?
4. Distinguish between arteries and veins.
5. Why AB+ blood group is considered as universal recipient ?

### **LONG ANSWER TYPE QUESTIONS**

6. Explain the structure of human heart with the help of diagram.
7. Define cardiac cycle. Explain the changes occurring in heart during cardiac cycle..
8. What is lymph ? Explain its important functions. Write about its circulation.
  9. Draw a diagram showing how blood in the capillaries, surrounding tissues exchange respiratory gases with cells of the tissues. Label the following on this diagram :

(i) Red Blood Corpuscle      (ii) Tissue Cell      **[CBSE, 2005]**

**10.** Why is it essential to match the blood groups of the 'donor' and the 'receiver' persons before arranging transfusion of blood ? A person tests as 'universal donor'. which group of blood will be acceptable to him for receiving blood transfusion ?

# EXCRETION

## 6.1 EXCRETION :

There are various metabolic activities which take place inside the living organisms. All these activities are chemical reactions. As a result in animal body several end products are formed which are of no use to the cells. These are called as **wastes**. These must be removed from the body for proper functioning of the body. The elimination of these waste nitrogenous products from the body is called as **excretion**. Waste material is ammonia, urea, uric acid, carbon dioxide, pigments, salts digestive wastes, excess of water etc. Ammonia, urea uric acid are waste nitrogenous products, The excretory products are both volatile and non-volatile. These are removed from the body by different methods.

### 6.1(a) Excretion in Amoeba :

Amoeba is an ammonotelic organism since the principal excretory product is ammonia. Special excretory organelle in Amoeba is lacking. CO<sub>2</sub> and ammonia are excreted by diffusing in solution through plasma membrane. The concentration of ammonia is always higher in Amoeba than in the surrounding water. The water enters through plasma membrane by “**endosmosis**”. Ammonia is formed in cytoplasm by metabolism. Surplus water enters contractile vacuole. This surplus water can rupture the animal's body. Thus size of contractile vacuole increases, when the contractile vacuole is fully expanded with water, it moves towards the periphery. As it comes in close contact with the plasma membrane, the contractile vacuole bursts. Thus excess of water (surplus water) is discharged in the surrounding water, this phenomenon

of controlling the amount of water in the body is called as “**osmoregulation**”.

### **6.1 (b) Excretion in Earthworm :**

In earthworm, the excretory organs are **nephridia**. The internal funnel-like opening is called as “**nephrostome**”. The waste material from body cavity (coelom) enters the nephridium through nephrosome. In the inner lining of nephridium, the cells absorb useful substances like glucose.

### **6.2S STRUCTURE OF A TYPICAL NEPHIRIDIUM :**

A typical nephridium consists of three parts : nephrostome, body and terminal duct. The nephridium communicates with the coelom (body cavity) through internal nephrostome. Nephrostome is a ciliated funnel which leads into body of nephridium through the neck. The body of nephridium consists of short straight lobe, a long spiral lobe with narrow apical part. Spiral lobe consists of proximal limb and distal limb. Neck of the nephridium leads into proximal part of spiral lobe and terminal duct leaves the proximal limb. The tubule of the neck enters the body of the nephridium and leaves the body as terminal duct. These tubules have ciliated tracts inside. The number of ciliated tracts depends upon the number of coils of the tubules. The terminal duct may open outside by nephridiopore or into the gut (alimentary canal).



## 6.2 (a) Functioning of Nephridium :

Nephridia are highly vascular and extract nitrogenous wastes from the blood. The nitrogenous wastes and useful substances (glucose) enter the body of nephridium through internal nephrostome in the fluid form. The cilia present in the tubule beat to move the fluid. Useful substances like glucose are reabsorbed by cells, lining the tubule and is passed into the blood. The remaining waste is discharged into the alimentary canal or to exterior through nephridiopore. According to the position of nephridia in the body of earthworm, nephridia are of three types :

(i) Septal nephridia are attached on septa. Nephridiopore is missing.

(ii) Integumentary nephridia are attached on inner side of the skin.

Nephridiopore is present.

(iii) Pharyngeal nephridia are present as three pairs of groups of nephridia, on both sides of alimentary canal. Nephridiopore is absent. Septal and pharyngeal nephridia are endonephric as these open in the alimentary canal. Integumentary nephridia are ectonephric. Excretion is an adaptation to conserve water. Earthworm is ammonotelic (excrete ammonia) in excretion, in sufficient water while it is ureotellic (excrete urea) on land.

## 6.3 HUMAN EXCRETORY SYSTEM :

As a result of various metabolic process going on in our body a number of waste products are formed. These have to be eliminated as they are toxic to the body.

• **The waste products include :**

(i) **Carbon dioxide** which is liberated during respiration; and is eliminated by the lungs.

(ii) **Nitrogenous metabolic wastes**, such as urea and uric acid produced in the liver from excessive proteins.

(iii) **Bile pigments** : Bile pigments (**e.g., bilirubin**) derived by the

breaking down of hemoglobin of the erythrocyte.

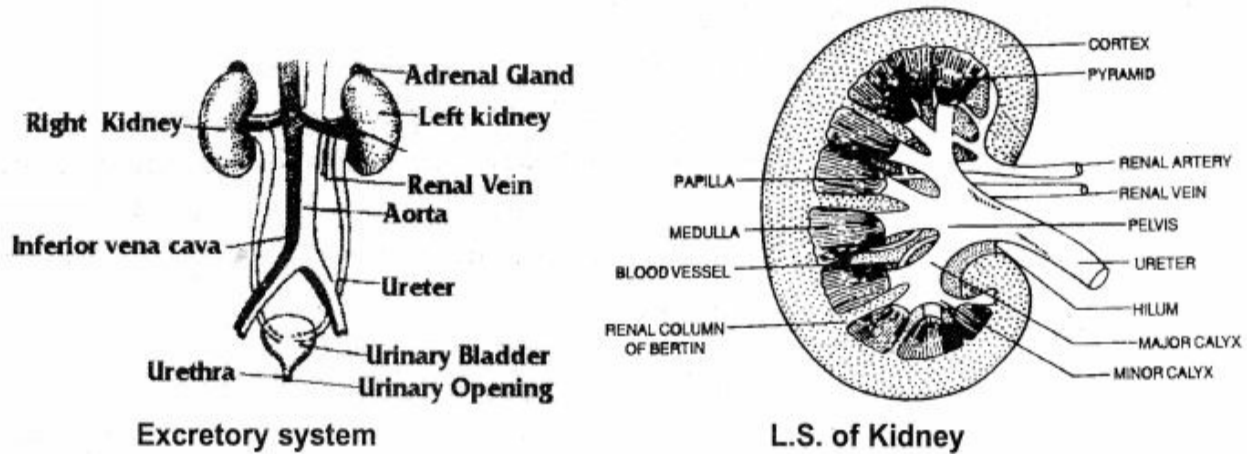
**(iv) Excess salts, water and vitamins :** Concentration of these substance above the required level, is harmful to the body. Elimination of all metabolic nitrogenous wastes from the body is called as **excretion.**

#### **6.4 ORGANS OF EXCRETION :**

**(i) Lungs :** Carbon dioxide produced by the oxidation of glucose or other food substances in the tissues is removed by the blood. This carbon dioxide is carried to the lungs through the blood vessels (veins) where it diffuses into the alveoli and out through the respiratory tract. Water vapour in small amount is also exhaled during expiration from the lungs.

**(ii) Skin :** Substances like soluble food matter, oxygen, water dissolved mineral salts, traces of urea and uric acid diffuse from the thin walls of capillaries into the walls of the sweat glands. Oxygen and food substances are used for metabolic activities of the cells of sweat glands but the remaining metabolic wastes are excreted out of the gland through the sweat duct which opens on the surface of the skin through sweat pore. Sweat contains 99% water, traces of urea and uric acid. However, after heavy exercise, lactic acid forms a major constituent of sweat. Profuse sweating may lead to sodium deficiency, leading to muscle cramps. An adaptation for prevention of water loss is the impermeability of our skin to water. However, in aquatic animals, skin is the major excretory organ. They excrete ammonia through their skin by diffusion as ammonia is highly soluble in water.

## 6.5 INTERNAL STRUCTURE OF KIDNEY :



(i) **Bowman's capsule** : It is a single-cells thick, double walled cup-shaped structure present in the cortex region of the kidney. The cup-shaped capsule contains a network of capillaries called **Glomerulus's**. Glomerulus's and Bowman's capsule are together called as **Renal corpuscle**.

(ii) **Proximal convoluted tubule (PCT)** : It starts after the Bowman's capsule and is greatly twisted. The whole P CT lies in the cortex region.

(iii) **Henle's loop** : Henle's loops is a U-shaped tubule located in the medulla region. it consists of

(A) a thin-walled descending limb in the medulla

(B) a thick-walled ascending limb in the cortex. Henle's loop is long in those animals which pass hypertonic urine.

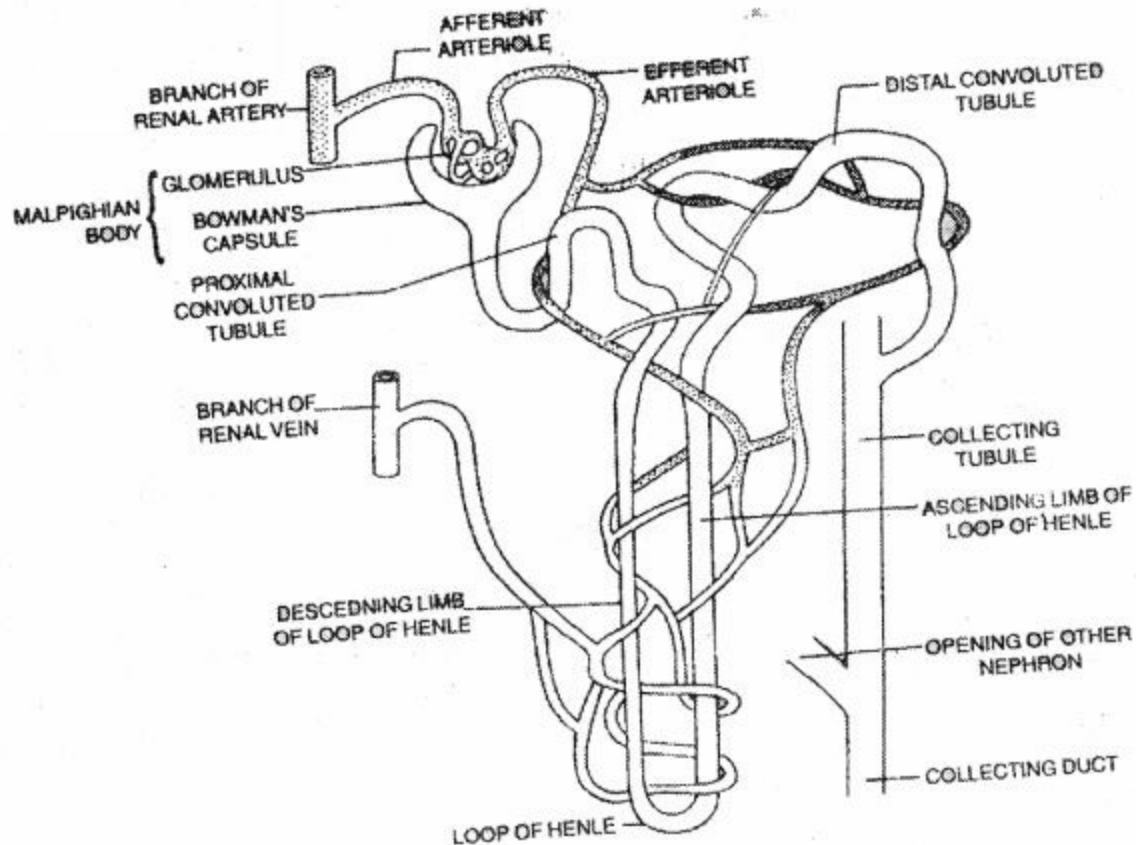
(iv) **Distal convoluted tubule** : The ascending limb continues into the distal convoluted tubule which forms several coils in the cortex.

(v) **Collecting duct** : Collecting tubule receives distal tubules of several uriniferous tubules. Several such tubules unite to form a large

collecting duct. The collecting ducts are held together and converge to form a **pyramid**. The pyramid opens into the pelvis which leads into the ureter.

## **6.6 BLOOD SUPPLY TO NEPHTRONS :**

Inside the kidney, the renal artery branches into a number of renal arterioles. A branch from a renal arteriole enters each Bowman's capsule, and is called the **afferent arteriole**. It breaks up into a network of capillaries which reunite to form a **efferent arteriole**. (Glomerulus is a mass of network of capillaries in the Bowman's capsule). The efferent arteriole after emerging from the Bowman's capsule runs a short distance and breaks up into a capillary network which surrounds the renal tubule and rejoins to form a vein. By reuniting again and again with other veins of the kidney it forms the renal vein which drains into the posterior venacava.



**Functional unit of kidney -nephron**

## 6.7 CHEMICAL COMPOSITION OF URINE :

Normal human urine consists of about 95% water and 5% of solid wastes. Besides the normal constituents, certain hormones and medicines like the antibiotic and excess vitamins are passed out with urine. Organic compounds (gm/l): Urea - 2.3; Creatinine - 1.5; Uric acid - 0.7; Ammonia - 0.6 Inorganic Compounds (gm/l) NaCl - 19.0; KI - 12.5;  $H_2SO_4$  - 1.8;  $NH_3$  - 0.6. Normally a man excretes 1000 - 1700 ml of urine daily, depending upon the water intake, diet, climate, mental state and physiological condition. Tea, coffee, alcohol and other beverages increase the formation of urine.

### 6.7 (a) Working of Nephron :

Main function of nephron is to form urine. There are three main

process involved in the urine formation :

**(i) Glomerular ultrafiltration :** It is the filtration of body fluids and solutes from the blood, out of the glomerular capillaries into the Bowman's capsule due to the pressure in the glomerulus. All substances from the blood are filtered out except the large protein molecules. This fluid in the glomerular capsule is called as **glomerular filtrate**. It consists of water, urea, salts, glucose and other plasma solutes. Blood coming out of the efferent arteriole is therefore thick.

**(ii) Tubular reabsorption :** Glomerular filtrate contains a lot of useful materials like glucose, salts such as that of sodium and water. These substances are reabsorbed from the renal tubule at various levels and in various proportions. **Glucose** is reabsorbed completely from the proximal convoluted tubule. More than 85% of **water** is reabsorbed from the proximal, distal and even in collecting tubules. **Sodium chloride** is reabsorbed in the proximal and distal tubules. **Potassium** and **phosphate** is completely reabsorbed from the proximal tubule. Other substances reabsorbed are uric acid, sulphates, vitamin C, amino acids etc.

**(iii) Tubular secretion :** This occurs mainly in the distal convoluted tubule and the collecting duct of the nephron. It is an active, vital process performed by the cells of the cuboidal epithelium lining the tubules which excrete additional wastes from the blood stream into the filtrate by active transport. In this process substances like potassium, hydrogen, creatinine and certain drugs like phenol, penicillin etc. are directly excreted by the tubular cells from the blood. The fluid which now flows through the last parts of the tubule is urine which consists of water, urea, uric acid, mineral ions like sodium, potassium, chlorides, phosphates etc.

## 6.8 ARTIFICIAL KIDNEY :

In case of loss or damage of one kidney, the other kidney performs the

function of both the kidneys and the person can lead a normal life. But the failure of both the kidneys leads to death. Artificial kidney is a **dialysis** machine which cleans blood of waste products, thus acting like a kidney. The patients' blood is led from the radial artery of the arm through the machine where urea and other salts are removed and pure blood is returned to vein in the same arm. In case of permanent damage to the kidneys, dialysis has to be performed for about twelve hours, twice a week. Patients with chronic kidney failure have been recorded to survive for more than 12 years on dialysis. Now a days, diseased kidney may be replaced with healthy one by **kidney transplantation**. To lead a normal life, one healthy kidney is more than enough. Therefore, a healthy person can donate his one kidney to patient who has both kidneys impaired.

## DAILY PRACTICE PROBLEMS # 6

### OBJECTIVE QUESTIONS

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- Which of the following parts of a kidney contains the lowest concentration of urea ?  
(A) Loop of Henle                      (B) Branches of renal vein  
(C) Bowman's capsule                (D) Glomerulus
- Urinerous tubules of a kidney are concerned with formation of  
(A) glucose                      (B) amino acids                      (C) hormones                      (D) urine
- Excretion is removal of  
(A) CO<sub>2</sub>                      (B) harmful and useless ingredients  
(C) extra water                      (D) metabolic wastes
- Main function of kidney is  
(A) passive absorption                (B) ultrafiltration  
(C) selective reabsorption                (D) Both B and C
- Ammonia is converted into urea in  
(A) kidney                      (B) spleen                      (C) liver                      (D) nephron
- Function of loop of Henle is  
(A) conservation of water                (B) formation of urine  
(C) filtration of blood                      (D) passage of urine
- Urea is transported through  
(A) RBCs                      (B) WBCs                      (C) Plasma                      (D) All of the above
- Major function of contractile vacuole is  
(A) excretion                      (B) circulation                      (C) osmoregulation                      (D) all the above
- Which one is an accessory excretory organ



- (A) Liver                      (B) Stomach                      (C) Intestine                      (D)  
Heart

## **SUBJECTIVE QUESTIONS**

### **VERY SHORT ANSWER TYPE QUESTIONS**

1. Name of excretory organs of amoeba.
2. How wastes diffuse out from body of Sponge and Hydra ?
3. Flame cells are excretory organs of which group of animals.
4. Name the major excretory product of human beings.

### **SHORT ANSWR TYPE QUESTIONS**

5. What is meant by excretion and osmoregulation ?
6. How excretion takes place in amoeba ?
7. Draw a diagram of nephron and label its various parts.
8. What is meant by osmoregulation ? How it is achieved in different groups of animals ?

### **LONG ANSWER TYPE QUESTIONS**

9. Name the excretory organs of earthworm.
10. Draw diagram of human excretory system, label its pars.
11. Draw a labelled diagram of nephron and explain how urine is formed.

## **ANSWERS**

### **DAILY PRACTICE PROBLEMS # 4**

<b>Qus.</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>	<b>9</b>	<b>10</b>
<b>Ans.</b>	<b>B</b>	<b>B</b>	<b>B</b>	<b>C</b>	<b>C</b>	<b>B</b>	<b>C</b>	<b>B</b>	<b>D</b>	<b>B</b>

### DAILY PRACTICE PROBLEMS # 5

<b>Qus.</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>	<b>9</b>	<b>10</b>
<b>Ans.</b>	<b>A</b>	<b>A</b>	<b>C</b>	<b>A</b>	<b>A</b>	<b>D</b>	<b>B</b>	<b>B</b>	<b>A</b>	<b>B</b>

### DAILY PRACTICE PROBLEMS # 6

<b>Qus.</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>	<b>9</b>
<b>Ans.</b>	<b>B</b>	<b>D</b>	<b>D</b>	<b>D</b>	<b>C</b>	<b>A</b>	<b>C</b>	<b>C</b>	<b>A</b>

# RESPIRATION

## 7.1 RESPIRATION :

The sum total of all the vital activities is called as **metabolism**. Vital activities refer to all the physiochemical activities of a cell. It has two aspects :

**(i) Anabolism** : It includes metabolic process by which complex cellular compounds are synthesized from simpler compounds, **.e.g. Photosynthesis**

**(ii) Catabolism** : It includes metabolic processes by which larger molecules are broken down into simpler molecules, **e.g. Respiration**. Respiration is an important catabolic process responsible for the production of energy.

### 7.1 (a) Definition :

The process by which assimilated food is oxidized and energy is released is called as respiration. In this process oxygen from air is taken in, this oxygen reacts with food molecules present in the body cells and burn them slowly to release energy. This energy is stored in the form of ATP molecules inside the cell for further use and the waste products i.e. CO<sub>2</sub> and H<sub>2</sub>O are eliminated out of the body.



It is called as aerobic respiration.

**NOTE** : The process by which organisms obtain oxygen from environment and release carbon dioxide produced

during oxidation of food to the outer environment is called as breathing. It is a part of respiration.

## 7.1 (b) Difference Between Breathing and Respiration :

- (i) Breathing involves taking in of oxygen and releasing out of carbon dioxide so it is a physical process while respiration is a biochemical process which, along with breathing involves oxidation of food.
- (ii) Breathing involves lungs so it is an organ system level process while respiration besides being at organ system level, also occurs at cellular level.
- (iii) Breathing itself do not release energy while respiration results in the release of energy which is then stored in form of ATP.

(iv) Breathing is a part of respiration while respiration is not a part of breathing but it involves breathing.

## 7.1 (c) Types of Respiration :

**(i) External respiration :** Exchange of gases between an organism and its environment.

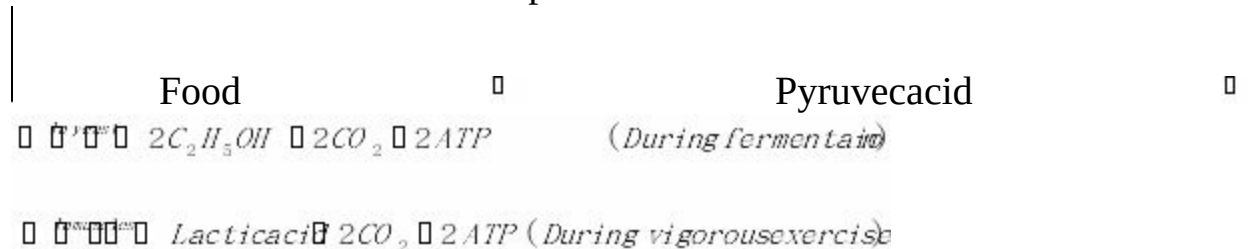
**(ii) Internal respiration :** Exchange of gases between tissue cells and extra cellular environment.

**(iii) Aerobic :** When oxidation of food takes place in presence of molecular oxygen.



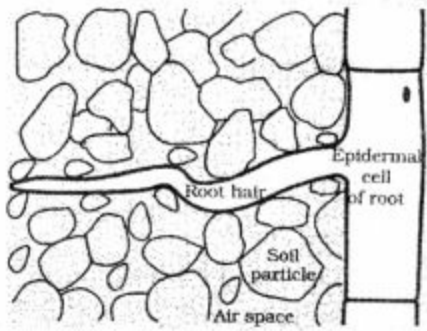
it is called as aerobic respiration.

**(iv) Anaerobic respiration :** When oxidation of food material does not require molecular oxygen or it occurs in absence of molecular oxygen, it is called as anaerobic respiration.



## 7.1 (d) Respiration :

Respiration in divided in three parts :



(i) Cellular respiration (ii)

Respiration in plants (iii) Respiration in animals

### 7.1 (e) Respiration Plants :

- In plants exchange of gases takes place from leaves, stems and roots individually.
- Transfer of respiratory gases from one part to another is very less.
- Exchange of gases in plants occurs

by simple diffusion.

#### (i) Respiration in roots :

- In young roots, the epidermal cells are extended to form root hair. These root hair remain in direct in contact with the air present in between the soil particles. The oxygen from this air enters into the root hairs by simple diffusion and reaches to other cells of root for respiration.
- In older roots a protective layer of dead cells is present which have tiny openings called as **lenticels**. Diffusion of oxygen takes place through these pores and carbon dioxide is released out through the same.

#### (ii) Respiration in stem :

- In herbaceous plants, stem have small openings in their epidermal cells called as **stomata**, the oxygen from air enters through stomata and

carbon dioxide is released from the same.

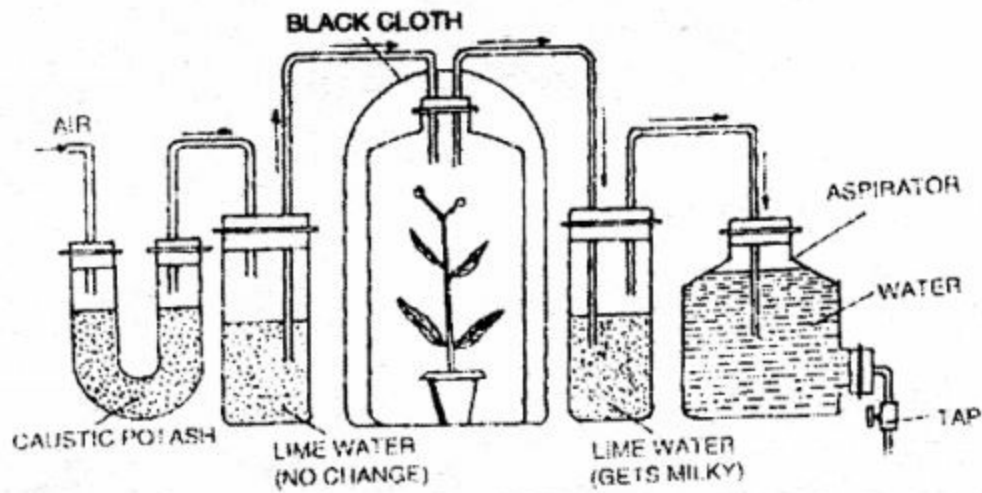
- In hard and woody stems of big plants and trees, lenticels are present in place of stomata through which exchange of gases takes place.

**(iii) Respiration in leaves :**

- Surface of leaves possess numerous tiny pores called as stomata in their epidermal cells, exchange of gases takes place through stomata and when  $\text{CO}_2$  concentration in cell increases stomata opens and  $\text{CO}_2$  is released out.

- An experiment to show that plants take oxygen and evolve carbon dioxide during respiration :

- **Experiment :** To demonstrate the plants take oxygen and evolve dioxide during respiration set the apparatus according to figure by taking KOH in U-tube, lime-water in two wide mouth bottles, one potted plant, bell jar and black-cloth. During day time the potted plant is covered with black-cloth to check photosynthesis. Make the apparatus airtight and start the aspirator. After sometime you will find that the lime water of second bottle turns milky. The explanation for this is that when the water comes out from aspirator, the atmospheric air enters into the apparatus through the second end and passes through the U-tube containing caustic potash into the tube containing lime water. The caustic potash absorbs the  $\text{CO}_2$  of the air. Thus,  $\text{CO}_2$  free air reaches into lime water so it does not turn milky. If indicates the air does not contain even trace of  $\text{CO}_2$ . When this air reaches into the lime water of second tube through a bell jar having potted plant covered with black cloth to check photosynthesis, it turns milky. It proves that  $\text{CO}_2$  is evolved during respiration.



## 7.2 RESPIRATION IN ANIMALS :

- Respiration in animals takes place as a single unit, they have different types of organs for respiration due to which mode of respiration also varies according to the organism but the basic mechanism is same.
- From phylum Protozoa to Ctenophore respiration is by generally body surface, in phylum Platyhelminthes to Nematodes are mostly anaerobic and endoparasites, in phylum Annelida cutaneous membrane occurs and then from phylum Arthropoda till Mammals various respiratory organs were developed like trachea, gills and lungs.

Type of respiration involved	Example	Organs
1. Cell surface respiration	Amoeba, Paramecium	General body surface
2. Tracheal respiration	Insects	Trachea and tracheoles
3. Branchial respiration	Fishes	Gills
4. Cutaneous respiration	Frog	Skin
5. Pulmonary respiration	Amphibians, reptiles, birds	Lungs
6. Buccal respiration	From	Buccal cavity

**Some important characteristics of respiratory organs of animals are :**

- They have large surface area to get enough oxygen.
- They have thin walls for easy diffusion and exchange of gases.
- They have rich blood supply for transport of respiratory gases.

### **7.2(a) Respiration in Amoeba :**

In unicellular organisms like amoeba and in some lower multicellular animals like sponges and cnidarians, respiration or exchange of gases occurs through general body surface as these cells are in direct contact with an aquatic environment so the oxygen dissolved in water diffuses into the cell and brings about oxidation of food, at the same time carbon dioxide released is expelled out of the cell by the same process.

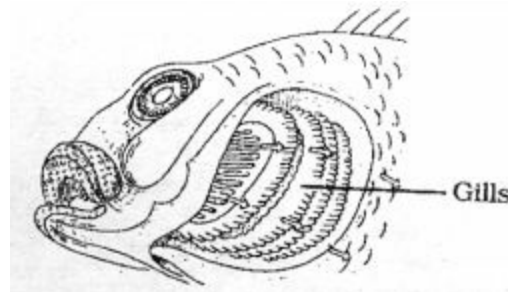


## 7.2(b) Respiration in Earthworm

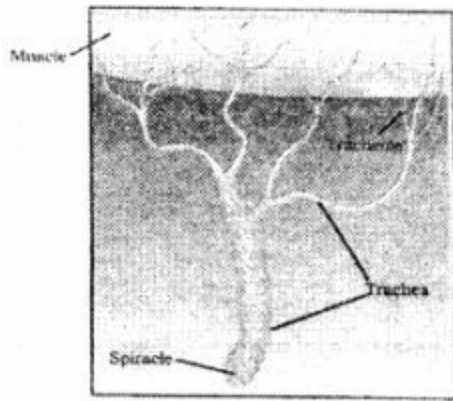
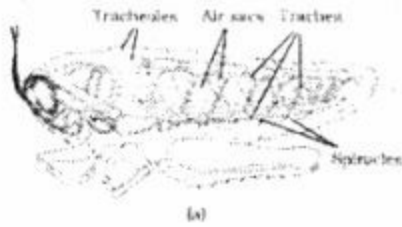
In organisms like earthworm and leech exchange of gases occur through their skin as their skin is very thin and moist. It is rich in blood supply so the oxygen is absorbed by moist skin of earthworm and is transported to all the cells of body through blood. The carbon dioxide from body cells diffuses into the blood and expelled out through skin.

## 7.2 (c) Respiration in Fish :

- In fish exchange of gases occurs through gills so the respiration is said to be branchial.
- Gills are present on both the sides of its head, they are covered by gill covers.



- During breathing fish takes in water through its mouth and pass it over the gills, the oxygen present in water extracted by gills and water is removed out through gill slits. This oxygen is now absorbed by blood and carried to all parts of the body and at the same time carbon dioxide is released into the blood and comes back to the gills and is expelled out into the surrounding water.
- Same type or respiratory pattern is followed in some other aquatic organisms like prawns.



(b)  
Tracheal system of an insect.

## 7.2 (d) Respiration in Grasshopper :

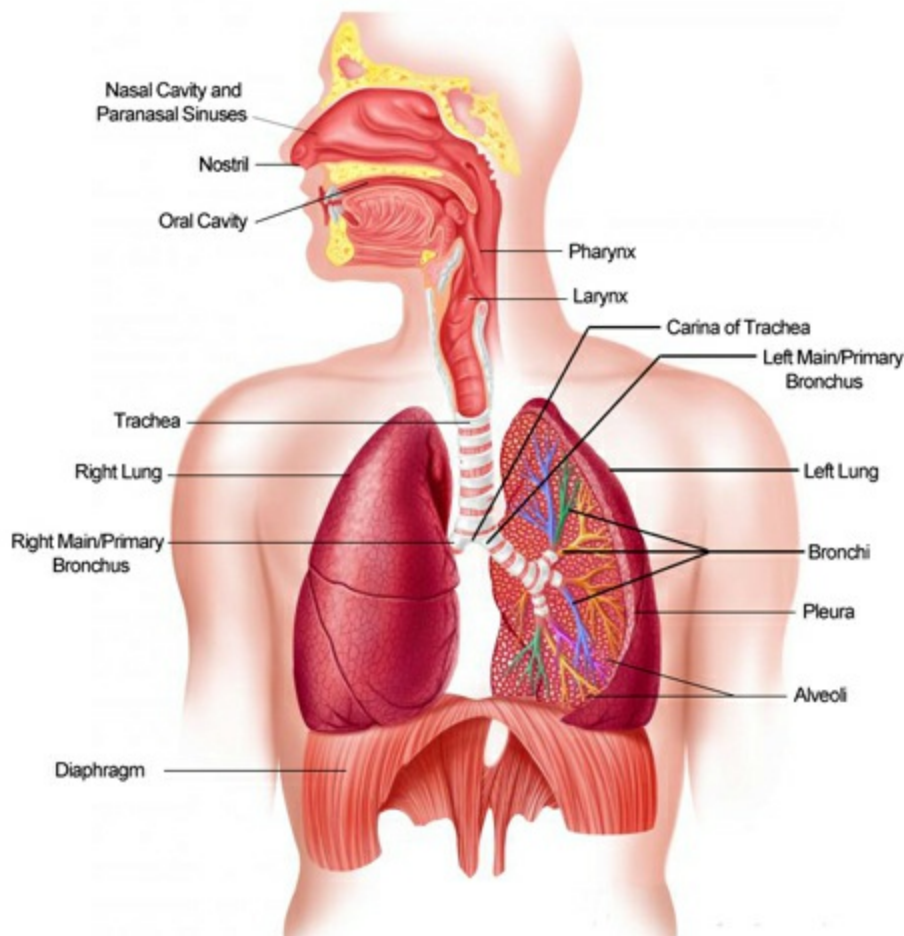
- In insects there occurs a system of tiny holes and air tubes all over the body these tiny holes or openings are called as **spiracle**. This whole system facilitates the exchange of gases and is called as **tracheal system**.
- During breathing oxygen of air enters the spiracle and reached to each and every part of grasshopper's body through trachea and tracheoles and carbon dioxide produced during respiration is carried back by trachea and tracheoles to the spiracles and is expelled out of the body of insect.
- The same mechanism is followed in other insects like houseflies, mosquitoes, bees etc.

## 7.2 (e) Respiration in Humans :

- **Human respiratory tract**

**(i) External nostrils** : First part of respiratory system. It opens into nasal cavity and is meant for inhalation of air from outside.

**(ii) Nasal cavity** : This cavity is separated from oral cavity by means of a hard and bony palate. It is lined by ciliated columnar epithelial cells that are rich in mucus; it brings about warming, moistening and sterilization of air. It contains hair and mucus which entrap the dust particles.



**(iii) Internal nares** : Nasal cavity opens into it and it leads to pharynx.

**(iv) Pharynx** : It is a common part between both alimentary canal and respiratory system.

**(v) Larynx** : It is an enlarged part of trachea which is also called as

**‘voice box’**. It produces voice by passage of air between vocal cords. It contains four different types of cartilages among them a ‘c’ shaped thyroid cartilage protruding out in neck region is called Adam’s apple.

**(vi) Trachea** : also called wind pipe. It is 10-12 cm long tube. It’s walls are supported by 16 - 20 ‘c’ shaped cartilaginous rings which prevent them to collapse when air is absent in them

**(vii) Bronchi** : Trachea is branched into two bronchi left and right each of which enters into the lungs.

**(viii) Lungs** : These are two light weight spongy pouches covered by a membrane called **Pleura**. Bronchi are further branched into several bronchioles, at the end of bronchioles **alveolar sacs** or **alveoli** are present which are rich in blood capillaries and thin walled.

**(vi) Diaphragm** : It is a sheet of muscles that lies below the lungs and separates thoracic cavity from abdominal cavity.

• **Mechanism of breathing** : It includes

**(i) Inhalation** : When air is breathed in, the diaphragm and muscles attached to the ribs contract due to which there occurs expansion of chest cavity, it results increase in volume of chest cavity thus the air pressure decreases and air from outside rushes into the lungs and alveolar sacs get filled with air containing oxygen. The oxygen present in air diffuses into the blood and CO<sub>2</sub> from blood diffuse out into alveolar sac.

**(ii) Exchange between blood and tissues** : CO<sub>2</sub> is taken by blood and O<sub>2</sub> diffuses into tissues.

**(iii) Exhalation** : When air is breathed out the diaphragm and muscles attached to ribs relax, which brings about contraction in chest cavity, its volume gets reduced and CO<sub>2</sub> is pushed out from lungs into the air

through trachea and nostrils.

## DAILY PRACTICE PROBLEMS # 7

### OBJECTIVE QUESTIONS

- The process of respiration is concerned with  
(A) liberation of oxygen                      (B) liberation of carbon dioxide  
(C) liberation of energy                      (D) intake of oxygen
- The common immediate source of energy for cellular activity is  
(A) NAD      (B) ATP      (C) DNA      (D) RNA
- The tissue respiration refers to  
(A) inspiration      (B) external respiration      (C) internal respiration      (D) expiration
- If the  $\text{CO}_2$  concentration in the blood increases, the rate of breathing will  
(A) decrease      (B) stop      (C) increase      (D) have no effect
- Vocal cords occur in  
(A) pharynx      (B) glottis      (C) bronchial tube      (D) larynx
- In man, which of the following structures is analogous to the spiracles of cockroach ?  
(A) Alveoli      (B) Lungs      (C) Bronchioles      (D) Nostrils
- Which of the following prevents collapsing of trachea ?  
(A) Diaphragm      (B) Ribs      (C) Cartilaginous ring      (D) Muscles
- Which of the following gases makes the most stable combination with

the hemoglobin of red blood cells.

(A) CO<sub>2</sub>                      (B) CO                      (C) O<sub>2</sub>                      (D) N<sub>2</sub>

9. Volume of air inspired or expired with each normal breath is called

(A) tidal volume                      (B) inspiratory capacity  
(C) total lung capacity                      (D) residual volume

10. Most of the carbon dioxide in the blood is carried in the form of

(A) carbonic acid                      (B) bicarbonates  
(C) carbaminohaemoglobin                      (D) dissolved CO<sub>2</sub>

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## SUBJECTIVE QUESTIONS

### SHORT ANSWER TYPE QUESTIONS

1. Define respiration. Name the different types of respiration.
2. Write three common features of respiratory organs.
3. What are the characteristics of respiratory structure present in animals ?
4. What is the function of epiglottis in man and where it is situated ?
5. How does exchange of gases takes place in the following :  
(i) Roots                      (ii) Stem                      (iii) Leaves
6. Draw a labelled diagram of human respiratory system.

### LONG ANSWER TYPE QUESTIONS

1. What do you mean by inhalation and exhalation ? Explain the mechanism of both in brief ?
2. List out the differences between breathing and respiration.
3. Describe the mechanism of breathing in human beings.
4. Explain the process of respiration in different parts of plant. What are the various structures involved in respiration in plants ?
5. Draw the respiratory system of human beings. What happens to

the rate of breathing during vigorous exercise and why ?

**6.** List three differences between respiration in plants and respiration in animals. Describe with a well labelled diagram how gaseous exchange occurs through root hair in plants

**[C.B.S.E., Delhi - 2005]**

**7.** How is respiration differs from breathing ? Explain the process of aerobic respiration and anaerobic respiration.

**[C.B.S.E - 2005]**

**8.** Draw a diagram showing human respiratory system. Label its following parts :

(i) Larynx (ii) Trachea (iii) Primary bronchus (iv) Lungs

**9.** Name the respiratory organs in the following :

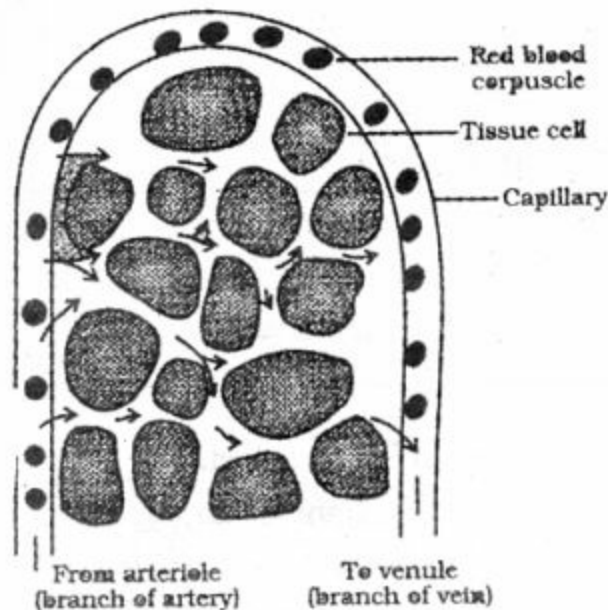
(i) A fish (ii) A bird (iii) An earthworm

**10.** Draw a diagram showing how blood in the capillaries surrounding tissues exchange respiratory gases with cells of the tissues.

# RESPIRATION

## 8.1 MACHANISM OF GASEOUS EXCHANGE BETWEEN TISSUES AND BLOOD :

When the air enters into the lungs through nostrils, trachea and bronchi it enters into the bronchioles, from bronchioles it moves into thin walled alveolar sacs or alveoli. Alveoli are rich in blood capillaries, at this place oxygen from air diffuses into the blood and reaches to all the cells and tissues of body this oxygen now diffuses into the cell and is utilized for the oxidation of food and production of energy in mitochondria as a result of this carbon dioxide is produced in cells, due to this increased concentration of  $\text{CO}_2$ , it diffuses into the blood and is brought back to alveoli and expelled out of the lungs through trachea and nostrils.





### 8.1 (a) Control of Respiration :

Respiration is controlled by the respiratory centre situated in medulla oblongata of brain.

- (i) Breathing occurs involuntarily.
- (ii) Under normal conditions rate of breathing is 15-18 times per minute. During vigorous exercise the demand for oxygen increases due to which rate of breathing increases by about 20-25 times.
- (iii) The total area for gas exchange covered through 300 million alveoli is about 36-72 m<sup>2</sup> in each lung.
- (iv) **Respiratory quotient** : It is defined as the ratio of the volumes of CO<sub>2</sub> liberated and O<sub>2</sub> used during respiration.

### 8.1 (b) Some Respiratory Disorders :

- **Emphysema** : It occurs due to infection, smoking etc. It occurs due to obstructions in bronchioles caused by breaking of alveolar septa. Bronchodilators and O<sub>2</sub> therapy are used, for curing this disease.
- **Asthma** : Air passages are narrowed and lead to obstruction in breathing.
- **Pneumonia** : Lymph and mucous accumulate in alveoli and bronchioles. It occurs due to bacterial and viral infection.
- **Bronchitis** : Swelling in living membranes of respiratory tract due to excessive smoking.
- **Tuberculosis** : Bacterial infection in lungs.
- **Pleurisy** : Inflammation of lung membrane called as pleurisy.
- Sudden contraction of diaphragm along with loud closure of glottis causes **Hiccough**.
- Sudden and violent expulsion of air through mouth and nose is called

a sneezing.

• **Fermentation** : the slow decomposition of organic matter into simpler substances in the presence of enzymes is known as **fermentation**. This process is used for preparation of alcoholic beverages in presence of yeast in the absence of oxygen. Glucose and fructose are converted to ethanol by this process. It is a type of anaerobic respiration.

### 8.1 (c) Difference Between Aerobic and Anaerobic Respiration

:

Aerobic	Anaerobic
(i) It occurs in all living cells of higher plants.	It occurs in bacteria, certain fungi, germinatin seeds and fleshy fruits muscles.
(ii) It requires oxygen.	Oxygen in not required
(iii) The end products are CO <sub>2</sub> and H <sub>2</sub> O.	The end products are alcohol or lactic acid and CO <sub>2</sub> .
(iv) The oxidation of one molecules of glucose produces 38 ATP molecules.	The number of ATP molecules produced is only 2.
(v) All the reactions except the reaction of glycolysis take place inside mitochondria.	All the reactions take place in cytoplasm.
(vi) Organic compounds are completely oxides and high amount of energy is realeased.	Organic compounds are incompletely oxidized and very small amount of energy is realeased
(vii) Non toxic to plants.	Toxic to higher plants.

### 8.1 (d) Differences Between Respiration and Photosynthesis :

Respiration	Photosynthesis
(i) It is a catabolic process.	It is an anabolic process.
(ii) Carbohydrates are oxidized.	Carbohydrates are synthesized.
(iii) Energy is liberated in the form of ATP.	Light energy is stored in the glucose or chemical energy.
(iv) The amount of CO <sub>2</sub> in the air increases during respiration.	The amount of CO <sub>2</sub> in the air during photosynthesis.
(v) It takes place in all the living cells, both green and non-green	It takes place only in chloro cells.
(vii) Dry weight of plant decreases.	Dry weight of plant increases.
(viii) Oxidative phophorylation	Photophosphorylatin occurs.

occurs (ix) O <sub>2</sub> is utilized and CO <sub>2</sub> and H <sub>2</sub> O are formed $C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 12H_2O + \text{energy}$	CO <sub>2</sub> and H <sub>2</sub> O are used which are evolved. $C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 12H_2O$
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### .1 ( e) Differences Between Respiration and Combustion :

<b>Respiration</b>	<b>Combustion</b>
(i) It is a biological process	It is a chemical process.
(ii) It takes place at normal temperature.	It takes place at high temperature.
(iii) Respiration is a slow process completed in several steps. Thus, the energy is also liberated in several steps and remains stored in the form of ATP.	Combustion is fast process in which the energy is liberated only in one step resulting in increase in temperature and production of fire.

### 8.1 (f) Cellular Respiration :

It refers to the oxidation of food taking place inside the cell. As this process is at cellular level so it is called cellular respiration. It takes place in three steps :

It refers to the oxidation of food taking place inside the cell. As this process is at cellular level so it is called cellular respiration. It takes place in three in 3 steps :

- (i) Glycolysis            (ii) Krebs Cycle            (iii) Electron Transport System

**Carbohydrates**

**During digestion**

**Glucose**

**Glycolysis**

**Pyruvic acid**

**in absence of O<sub>2</sub>**

**in presence of O<sub>2</sub>**

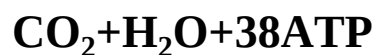
**Aneerobic respiration**

**Aerobic respiration**



**Kreb**

**Cycle**



### **8.1 (g) Glycolysis :**

Glycolysis also called **EMP pathway**, site-cytoplasm of cell.

(i) In this cycle glucose is converted into pyruvic acid in presence of many enzymes and co-enzymes.

(ii) Oxygen is not required during glycolysis.

(iii) 1 molecule of glucose gives rise to 2 molecules of pyruvic acid.

(iv) In this process 4 molecules of ATP are formed among them 2ATP molecules are utilized thus net gain of ATP is two molecules.

(v) 2NADP molecules are reduced to 2NADPH<sub>2</sub>, which later produces 6ATP molecules.

(vi) Overall production of ATP in glycolysis is **2ATP + 6ATP = 8ATP**

(vii) There is no production of CO<sub>2</sub> during this process.

**NOTE :** After glycolysis, pyruvic acid is converted into acetyl Co-A with the release of CO<sub>2</sub> and the process is called

as '**oxidative decarboxylation**'. It occurs in mitochondria of the cell. Besides this 6ATP are also formed during this step.

### **8.1 (h) Kreb Cycle :**

**Site : Mitochondria of cell**

(i) Also called aerobic oxidation.

(ii) Discovered by **Sir Hans Kreb**.

(iii) Another name TCA cycle (tricarboxylic acid cycle) or Citric acid cycle.

(iv) It brings about the conversion of pyruvic acid, fatty acids, fats and amino acids into CO<sub>2</sub> and water by oxidation.

(v) It is the common path for oxidation of carbohydrates, fats, proteins.

(vi) it accounts for **24ATP** molecules.

(vii) It starts with acetyl Co-A which is then converted into several intermediate compounds with the release of  $\text{NADPH}_2$ ,  $\text{FDH}_2$ ,  $\text{ATP}$ , hydrogen atoms and then Acetyl Co-A is regenerated back.

### 8.1 (i) Electron Transport System or ETS :

(i) In this hydrogen atoms produced during oxidation of various intermediates during Krebs cycle are first broken into protons and electrons.

(ii) These protons and electrons after passing through a series of coenzymes and cytochromes combine with oxygen to form water molecules.

(iii) During these series of events  $1\text{NADPH}_2$  releases  $3\text{ATP}$  molecules and  $1\text{FADH}_2$  gives  $2\text{ATP}$  molecules which were produced during Krebs cycle and glycolysis.

**NOTE :** The net gain of ATP molecules during respiration is  $38\text{ATP}$  molecules among them,

8ATP from glycolysis

6ATP from conversion of pyruvic acid into acetyl CO. A

24ATP from Krebs cycle

besides this  $\text{CO}_2$  and  $\text{H}_2\text{O}$  are also released.

#### **Some important points :**

(i) Diaphragm becomes flat during inspiration and becomes convex during expiration.

(ii) **Tidal volume :** Volume of air inspired or expired in relaxed position. It is around 500 ml.

(iii) **Residual volume :** Air left in the whole respiratory tract after forceful expiration. It is 1.5 liters.

(iv) **Total lung capacity :** Maximum amount of air the lungs can hold after forceful inspiration. It is about 5-6.0 litres.

(v) **Vital capacity :** Maximum amount of air which can be breathed out through forceful expiration after a forceful inspiration. It is 3.4-4.8 litres.

- Vital Capacity is more in athletes, mountain dwellers, non smokers.
- The total area for gas exchange provided by our 750 million alveoli in

two lungs in 100 S. m.

- In the cycle of inhalation and exhalation, repeated 15 to 18 times in a minutes about 500 ml of air is breathed in and out. In 24 hours, we breadth in 1500 litres of air.
- Blood is the medium for the transport of oxygen from the respiratory organ to the different tissues and carbon dioxide from tissues to the respiratory organs. As much as 97 percent of the oxygen is transported from the lungs to the tissues in combination with hemoglobin and only 2 percent is transported in dissolved condition by the plasma.
- A normal person has about 15 grams of hemoglobin per 100 ml of blood. One gram of hemoglobin binds about 1.34 ml of O<sub>2</sub>. Thus, 100 ml of blood carries about 20 ml of oxygen.
- Carbon dioxide is also transported by hemoglobin. When a respiring tissue release carbon-dioxide, it is first diffused in the plasma. From here it diffuses into the red blood cells. Carbon-dioxide is transported from the tissues to the lungs in the form of bicarbonates dissolved in water.
- About 23% of carbon dioxide entering into the erythrocytes combines with the globin (protein) part of haemoglobin to form carbaminohaemoglobin, which is transported to the lungs.
- Carbon monoxide binds with hemoglobin about 230 times more readily than oxygen. When a person inhales carbon monoxide, it diffuses from the alveolar air to the blood and binds to haemoglobin forming carboxyhemoglobin. The latter is a relatively stable compound and cannot bind with oxygen molecules. So, the amount of hemoglobin available for oxygen transport is reduced. The resulting deficiency of oxygen cases headache, dizziness, nausea and even death.
- **Mountain sickness** : It is also known as altitude sickness. At sea level the concentration of oxygen is about 21% and the barometric pressure averages 760 mm Hg. As altitude increases, the concentration remains the same but the number of oxygen molecules per breath is reduced. AT 12,000 feet the barometric pressure is only 483 mm Hg, so there are

roughly 40% fewer oxygen molecules per breath. In order to oxygenate the body effectively, breathing rate (even while at rest) has to be increased. This extra ventilation increases the oxygen content in the blood, but not sea level concentration. The fall in oxygenation of blood produced the symptoms of mountain sickness. These symptoms include breathlessness, headache, dizziness, nausea, vomiting, mental fatigue and a bluish tinge on the skin, nails and lips.

## DAILY PRACTICE PROBLEMS # 8

### OBJECTIVE QUESTIONS

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- Breathing rate in mammals is controlled by a part of the brain called the  
(A) thalamus (B) hypothalamus (C) medulla oblongata (D) cerebellum
- In anaerobic respiration  
(A)  $O_2$  is taken in (B)  $CO_2$  is taken in (C)  $O_2$  is given out (D)  $CO_2$  is given out
- Disease called pleurisy is due to  
(A) inflammation of pleura (B) inflammation of trachea  
(C) inflammation of alveoli (D) none of these above
- Leaves respire with the help of  
(A) lenticles (B) stomata (C) plasmodesmata (D) cuticle
- Correct statement is  
(A) roots of plant respire through lenticles and stomata.  
(B) stem of plant respire through lenticles  
(C) both A and B are correct  
(D) both A and B are incorrect
- Which of the following is not a characteristic of good respiratory surface ?  
(A) Thin and moist (B) Large surface area  
(C) Close to oxygen and gas transport (D) Thick and dry surface
- Respiration in yeast  
(A) takes place in the presence of oxygen and carbon dioxide (B) yields lactic acid



(C) in anaerobic and produces carbon dioxide (D) takes place only in darkness

8. Muscle cells engaged in vigorous activity build up a high concentration of

(A) lactic acid (B) pyruvic acid (C) alcohol (D) cholesterol

9. Exchange of respiratory gases takes place in an earthworm through

(A) moist skin (B) gills (C) trachea (D) lungs

10. Oxygen is transported in blood mainly by

(A) leucocytes (B) erythrocytes (C) thrombocytes (D) blood plasma

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## SUBJECTIVE QUESTIONS

### SHORT ANSWER TYPE QUESTIONS

1. Write any two points of difference between respiration in plants and respiration in animals.
2. What do you mean by fermentation ?
3. Describe the mode of respiration in an insect with a diagram.
4. What are the functions of respiratory system ?
5. Why do walls of trachea not collapse when there is less air in it ?

## LONG ANSWER TYPE QUESTIONS

6. Write the differences between photosynthesis and respiration.
7. Explain the following in brief :  
(a) Emphysema            (b) Asthma            (c) Pneumonia            (d) Bronchitis
8. Describe the structure of lungs.
9. Explain in brief all the organs involved in respiratory system.
10. Explain in brief the cellular respiration.
11. Explain the process by which inhalation occurs during breathing in human beings.
12. A farmer floods his field every day thinking that watering in this manner will result in a better yield of his wheat crop. What will be the result of this action of the farmer ? **[C.B.S.E, All India 2004]**
13. What is the function of epiglottis in man ? Draw labelled diagram showing the human respiratory system.  
**[All India C.B.S.E. -2004]**
14. Distinguish between aerobic and anaerobic respiration in terms of end products and energy ?  
**[C.B.S.E. - 2004]**

## ANSWERS

### DAILY PRACTICE PROBLEMS # 7

Qus.	1	2	3	4	5	6	7	8	9	10
Ans.	C	B	C	C	D	D	C	B	A	B

## DAILY PRACTICE PROBLEMS # 8

<b>Qus.</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>	<b>9</b>	<b>10</b>
<b>Ans.</b>	<b>C</b>	<b>D</b>	<b>A</b>	<b>B</b>	<b>B</b>	<b>D</b>	<b>C</b>	<b>A</b>	<b>A</b>	<b>B</b>

# CONTROL & CO-ORDINATION

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## 9.1 INTRODUCTION :

All the living organisms show the irritability or sensitiveness. It is the property to give response to the stimulus. The stimulus can be external or internal. The living organisms adapt themselves to the external and internal factors with proper adjustment. This adjustment of the vital activities of life is called co-ordination. The working of one system is co-ordinate with that of other system **.e.g., During** eating our body performs several kinds of coordinated activities. The nose differentiates the smell of food and hand serve as the organs of ingestion. the alimentary canal and glands help in the digestion of food. Thus various organs perform co-ordinate activities.

### 9.1 (a) Control and Co-ordination :

Control and co-ordination also help to maintain a steady state of stability and steady state within an organism in constantly changing environment. The mechanism of maintaining internal steady state is called **homeostasis**. A mountaineer feels lack of oxygen a high altitudes In order to cope with this condition, more number of RBCs are produced. It is the internal environment (physiologically) that adjusts to the external stress i.e. lack of oxygen. Similarly mammals are capable of maintaining a constant body temperature. The vital activities of an organism are controlled by endocrine system and nervous system. There are two types of co-ordinations i.e., nervous and hormonal co-ordination. In animals both hormones and neurons (structural and functional unit of nervous system) are involved in regulating and coordinating the various vital activities. In plants only chemical

(phytohormones) co-ordination is present.

## 9.2 CHEMICAL CO-ORDINATION IN PLANTS :

### 9.2 (a) Movements in Plants :

The plants are fixed in the soil so they cannot avoid various stimuli by moving away. There is no 'brain-like' structure in plants to adapt themselves according to the changes in their surroundings. Still the plants show the positive or negative responses to light, water, gravity, touch etc. The movements of plants due to stimuli are called the **tropic or curvature movements**. The response of a part of the plant to light is called **phototropism**. The stem is positively phototropic (grows towards light) while the root is negatively phototropic. The growth response of a part of plant to gravity (attraction force of the earth) is called **geotropism**. The shoot is negatively geotropic while the root is positively geotropic. **Chemotropism** is due to the chemical stimulus e.g. **growth of pollen tube**. The Response to a stimulus, independent of direction, is called **nastic movement**. The Leaves of **Mimosa pudica** (Touch-me-not) droop down (bend) on touching.

### 9.2 (b) Effect of Light :

Flowering and seed germination are regulated by the duration of light, This phenomenon called **photoperiodism**. Plants respond to this stimulus (light duration) with the help of phytochrome pigment. Phytochrome is a proteinaceous pigment and controls several light dependent developmental processes like germination, growth and flowering. Phytochrome exists in two forms Pr and Pfr . Pfr is active form and both are interconvertible.

### 9.2 (c) Photoperiodism and Flowering :

It is a physiological change occurring in plants in response to relative length of the day and light. The term photoperiodism was used by **Graner and Allard** for the response of plants to photoperiods expressed in the form of flowering. On the basis of photoperiod there are three classes of plants.

- (i) Short day plants                      (ii) Long day plants                      (iii) Day neutral plants

## 9.2 (b) Vernalization and Flowering :

The term vernalization was coined by **Lysenko** for promotion of flowering by a previous cold treatment. For flowering in winter varieties, winter cold treatment is necessary. In nature, plant requiring cold treatment usually behaves as biennial. They germinate and grow vegetatively in first season and produce flowers during second seasons after getting the cold treatment. The suitable temperature for vernalization is 4°C and time period varies from 4 days to 3 months.

**Table : Difference between phototropism and photoperiodism**

<b>Phototropism</b>	<b>Photoperiodism</b>
(i) It is a tropic movement (ii) The stimulus is perceived by apical meristem (iii) It is due to differential growth in elongation zone	(i) It is physiological response to relative lengths of day and night (ii) The stimulus is perceived by the leaves (iii) It is due to the replacement of vegetative buds by reproductive buds.

## 9.3 GROWTH REGULATORS :

The growth regulators are the important chemical affecting growth. Growth hormones (phytohormones) are the natural growth substances which are produced in any part of the plant and are transferred to another part and there they influence the growth of plant. The growth regulators consist of auxins, gibberellins, cytokinins, ethylene and abscisic acid. Except abscisic acid, ethylene the three are called growth hormones and ethylene, abscisic acid are growth inhibitor.

### 9.3 (a) Auxins :

Auxins are the growth hormones which were first discovered by Charles Darwin. Auxins are the weak organic acids which can promote elongation and growth. These are produced in the apical meristem (tips of root and stem), young leaves, flower buds and fruits. The first discovered plant hormone was identified as indole acetic acid (I.A.A.).

**(i) Functions of auxins :**

**(A) Cell enlargement and elongation :** Auxins loose the cell wall, increase membrane permeability and synthesis wall microfibrils. All these activities result in the cell enlargement and elongation.

**(B) Tissue culture**

**(C) Apical dormancy :** The presence of terminal or apical bud involves the failure of lateral bud growth. It is due to the secretion of IAA. Removal of apical bud results in the growth of lateral buds.

**(D) Root formation :** Auxins can induce adventitious roots in stem cuttings.

**(E) Cell division**

**(F) Parthenocarpy :** Application of synthetic as well as natural auxins to unpollinated pistils produces parthenocarpic fruits (seedless fruits). Parthenocarpy is the phenomenon of development of seedless fruits without pollination and fertilization. This phenomenon is applies in seed bearing fruits like grape, banana, papaya, tomato etc.

**(G) Curvature movements**

**(H) Abscission**

**(I) Lead and fruit fall :** 2, 4 -D (2, 4- dichlorophenoxy acetic acid) is applied to avoid pre-harvest fruit drop in oranges and apples.

**(J) Flowering :** Auxins generally inhibit flowering but in pineapple it cause flowering.

**(K) Weedcides :** The auxins play important role in weed control.

**(L) Storage :** Applied for potato storage.

### 9.3 (b) Gibberellins :

Gibberellins have a unique property of increasing the height of plants but they do not cause curvature. The gibberellins were first discovered in Japan by Yabuta and Sumiki. E. Kurosawa obtained extracts from rice plants which were infected with fungus **Gibberella fujikuroi**. These rice plants were taller and sterile.

**(i) Functions of gibberellins :** The physiological effects of gibberellins on plant growth are as follows :

**(A) Cell elongation :** Gibberellins cause stem elongation and expansion of leaves in intact plants.

**(B) Stem elongation :** These induce stem elongation in genetically dwarf varieties (pea, maize & Cabbage) It is called bolting.

**(C) Seed germination**

**(D) Flowering**

**(E) Parthenocarpy**

**(F) Counteract dormancy :** Natural dormancy of buds, tubers, rhizomes and some seeds can be overcome by gibberellins.

**(G) Induction of maleness :**  $GA_3$  induces the formation of male flowers on genetically female plants in Cucurbits.

**(H) Induction of aerial stem**

**(I) Increase in size of fruits :** Application of gibberellins increase bunch length and fruit size in grapes.

### 9.3 (c) Cytokinins :

The cytokinins are chemically basic growth hormones which promote cell division in plants. This group of phytohormones was discovered



when **Carlos Mille** isolated the crystalline substance from degraded DNA material. This substance was named as **kinetin**.

**(i) Function of cytokinins :** The important physiological effects of these cytokinins on plant growth are as follows :

**(A) Cell division :** One of the main functions of cytokinins is in cell division and more particular cytokinesis.

**(B) Secondary growth :** Cytokinins overcome apical dominance and promote the growth of lateral buds.

**(D) Senescence :** Cytokinins can inhibit or delay senescence (ageing). Leaves treated with cytokinins, retain chlorophyll for longer period i.e., they remain green for a longer period.

**(E) Morphogenesis :** A natural balance between auxins and cytokinins is responsible for differentiation of stems and roots (morphogenesis). When cytokinins are in excess, lateral buds develop while roots are formed if relatively more auxins are present.

**(F) Induction of flowering**

**(G) Callus growth**

### 9.3 (d) Ethylene :

This is a gaseous plant hormone which is produced by almost all the fleshy fruits during ripening. Ethylene is autocatalytic in nature. Higher concentration of auxins induce ethylene formation.

**(i) Functions of ethylene :** The important function of ethylene are as follows :

**(A) Fruit ripening :** It is used for artificial ripening of fleshy fruits in the shops.

**(B) Abscission layer :** Ethylene accelerates the abscission of leaves, flowers and fruits.

**(C) Senescence :** Ethylene induces yellowing of leaves and downward

bending. This results in the senescence in the plants.

**(D) Growth** : It promotes transverse expansion but it inhibits longitudinal growth.

**(E) Flowering** : It induced flowering in pineapple.

**(F) Dormancy** : It breaks the dormancy of several organs of plants except lateral buds.

**(G) Induction of femaleness** : It has feminizing effect. This increases the number of female flowers in Cucurbits.

### 9.3 (e) Absciscic Acid (A.B.A.) :

Stress hormone of plants is called as absciscic acid. It is also known as dormin. **Addicott and his co-workers** isolated as substance from young cotton bolls and named it as Absciscic acid. This acid is now isolated from dormant seeds, buds and other parts of the plants. Absciscic is a growth inhibitor. Absciscic acid has no stimulating effect on any aspect of growth.

#### **(i) Functions of absciscic acid :**

**(A) Growth** : A.B.A. has antagonistic property to growth promoting hormones (auxins, gibberellins and cytokinins). Thus it keeps the growth under check.

**(B) Dormancy** : A.B.A. induces dormancy in buds towards the approach of unfavorable conditions. it causes natural dormancy in seeds and tubers.

**(C) Abscission** : It promotes abscission in leaves, flowers and fruits and causes ageing in plants.

**(D) Wilting** : During drought it closes the stomata and checks loss of water by transpiration. This ensures the survival of plant undergoes wilting.

**(E) Resistance** : It promotes cold hardiness.

**(F) Flowering and seed development** : It is known to inhibit the process of flowering, fruit formation and seed development.

## **9.4 CHEMICAL CO-ORDINATION IN ANIMALS :**

Coordination in animals is brought about by the secretions of endocrine glands. **Endocrine glands** are ductless glands which secrete the chemical substances called hormones, Directly pour into the blood. Any chemical substance which is formed in the tissues of endocrine glands are carried by the blood to the other parts of the body for its specific actions is termed as **hormone**. An organ which responds to such a hormone is known as **target organ**.

### **9.4 (a) Characteristics of Hormones :**

- (i)** They are the secretions of endocrine glands.
- (ii)** They are produced at a place and act on target organs which are mainly away from their source.
- (iii)** They are poured directly into the blood stream.
- (iv)** They are required in very small quantities.
- (v)** they are specific in function.
- (vi)** Chemically they are mainly proteins. Some of them may be amino acids, steroids etc.
- (vii)** They are harmful if present in less or excess amounts.
- Viii)** Hormones are immediately destroyed after their action is over.

### **9.4 (b) Feedback Mechanism :**

Endocrine glands interact with each other, so that secretion of one gland may stimulate or depress the activity of another. The amount of hormone released by an endocrine gland is determined by the body's need at any given time e.g. The hypophysis produces a hormone that

stimulates the thyroid to produce its hormone; in turn the thyroid secretion induces the hypophysis to produce less thyroid stimulating its hormone; in turn the thyroid secretion induces the hypophysis to produce less thyroid stimulating hormone. This is known as the 'negative feedback'. This feed-back helps bring about a steady state in the body which is called as **homeostasis**.

## 9.5 VARIOUS ENDOCRINE GLANDS PRESENT IN THE HUMAN BODY ARE :

- (i) Pituitary gland (or Hypophysis)
- (ii) Pineal gland
- (iii) Thyroid gland
- (iv) Parathyroid gland
- (v) Thymus gland
- (vi) Adrenal gland
- (vii) Pancreas
- (viii) Ovaries
- (ix) Testes

### 9.5 (a) Pituitary Gland (or Hypophysis):

It is a small ovoid structure attached to the base of brain (hypothalamus) by a short stalk called **infundibulum** placed just behind the optic chiasma where the optic nerve from each eye meet. Pituitary gland is also known as the **master gland** as it controls other endocrine glands. This gland consist of three lobes-anterior, middle and posterior. Each lobe of the pituitary gland secretes different sets of hormones.

#### (i) Hormones of anterior pituitary :

**(A) Growth hormone (GH) :** This hormone promotes and regulates the process of growth in the body. It's deficiency during childhood lead to **dwarfism** and over secretion leads to **gigantism**.

**(B) Adrenocorticotrophic hormone (ACTH) :** This regulates the activities of adrenal cortex. It mainly stimulates the adrenal cortex to secrete corticosteroid hormone which defends the human body under stress.

**(C) Thyroid stimulating hormone (TSH) :** As is clear from its name it

controls the functioning of thyroid gland. It stimulates thyroid gland to secrete thyroxin.

**(D) Follicle stimulating hormone (FSH) :** It stimulates the production of gametes, stimulates the development of ovarian follicles in females, and its equivalent in the males stimulates sperm production.

**(E) Luteinising hormone (LTH) :** It causes ovulation and formation of corpus luteum, which secretes progesterone in females and stimulates the testis to produce testosterone in males.

**(F) Luteotrophic hormone (LTH) :** This is also known as prolactin. This hormone stimulates growth of mammary glands during pregnancy and promotes lactation after delivery. Prolactin level rises during pregnancy and is very high during lactation.

**(ii) Hormones of middle pituitary:**

**(A) Melanocyte stimulating hormone (MSH) :** This is the only hormone secreted by middle pituitary which controls the growth and development of melanocytes responsible for skin colour.

**(iii) Hormones of posterior pituitary :**

**(A) Vasopressin or Antidiuretic hormone (ADH):** This causes the reabsorption of water into the blood from the collecting tubules of the kidney's thereby concentrating the urine and reducing its volume.

**(B) Oxytocin :** This hormone stimulates uterine contractions at the time of child birth and causes release of milk from mammary glands. It is also known as birth hormone or milk-ejecting hormone.

### **9.5 (b) Pineal Gland :**

It is a small reddish-grey gland, about the size of a pea, attached to the roof of the third ventricle of the brain. It contributes to regulating gonadal development. It controls development & concentration of melanin.

### **9.5 (c) Thyroid Gland :**

The thyroid gland consists of two lobes joined together by an isthmus. It

is situated in the lower part of the neck and when enlarged it forms goitre. Two hormones secreted by the thyroid gland are :

**(i) Thyroxine :** It is the principal hormone secreted by the thyroid gland and its main role is to increase the metabolic rate of the organs and tissues of the whole body. 60% of thyroxine consists of iodine, an element which is essential for the gland to enable it to synthesize its hormone. The **basal metabolic rate (B.M.R.) is increased in hyperthyroidism and reduced in hypothyroidism.**

**(ii) Calcitonin :** This hormone lowers the calcium level in the ways :

**(A)** By inhibiting renal tubular calcium reabsorption.

**(B)** By inhibiting bone calcium reabsorption.

• **Hypothyroidism :** This results from lack or deficiency of thyroid hormone secretion. It is manifested differently in children as compared with adults. Cretinism affects children and is due to congenital defect of either absence or defect of the gland. In this disease growth is stunted, the features are coarse, frequently the child has a protruding tongue and an enlarged abdomen; the mentality of the child is low and retarded. **Myxoedema** is the condition caused by thyroid deficiency in adults. It affects women more frequently than men. It is characterized by puffy face, thick skin, dry cough, cold and loss of hair. There is a deposition of mucin and fluid retention in extracellular spaces. BMR is **lowered** Iodine deficiency causes **simple goitre.**

• **Hyperthyroidism :** This results from excessive secretion and over action of thyroid hormones, As excessive amount of thyroxine is poured into the blood and the metabolism of the body is speeded up. The person starts losing weight, has an increased pulse rate, suffers from nervous excitement and there is protrusion of eye balls. These toxic signs and symptoms are responsible for the condition being known as **toxic goitre.** Other names are thyrotoxicosis, exophthalmic goitre and grave's disease.

### 9.5 (d) Parathyroid Gland :

These are small ovoid pea shaped glands. They lie on the posterior surface of the thyroid gland. Usually there are two pairs of parathyroid glands, a superior pair and an inferior pair. The parathyroid secretion, **parathormone** has two main functions.

(i) It regulates the balance between the calcium in bones and in extracellular tissue fluid, thus affecting the amount of calcium in the blood.

(ii) It also controls the excretion of phosphates in the urine, probably by reducing tubular reabsorption of phosphorus by the kidney tubule.

### 9.5 (e) Thymus Gland :

This gland is situated in the thorax in midline under the sternum in front of trachea. It has two lobes which are further divided into many lobules. It secretes a hormone namely **thymosin**. It is one of the sites of lymphocyte formation in children. Recently thymus has assumed importance because of its role in immunological process. It helps in producing antibodies.

### 9.5 (f) Adrenal Glands :

These are two small semilunar structure lying one each on upper pole of the kidneys. That is why they are also known as **supra renal glands**. Each gland consists of two structurally and physiologically separate parts known as **cortex** and **medulla**. The cortex occupies outer peripheral portion which is yellowish in colour and medulla is inner brownish part. Cortex secretes three different kinds of hormones known as **corticosteroids**. They are :

(i) **Mineral corticoids** : These regulate sodium and potassium balance in the body.

(ii) **Glucocorticoids** : These derive their name from their influence on carbohydrate metabolism e.g. Glycogenesis is promoted in liver.

(iii) **Sex hormones** : Small quantities of sex hormones as androgens and oestrogen are produced by adrenal glands which influence sexual

development and growth.

- **Adrenal medulla** is important in raising defence mechanisms and supplementing sympathetic action in the body. It secretes two hormones.

(i) **Adrenaline** : It is a stress hormone causes increases in systolic blood pressure, dilation of coronary

blood vessels, increased sweating and increase in metabolic rate. It brings restlessness, muscle fatigue and anxiety.

(ii) **Noradrenalin** : It is a general vasoconstrictor, Increases both systolic and diastolic pressures. Both of these hormones are helpful in emergency conditions. Thus are called as “**fight or flight response**”.

### 9.5 (g) Pancreas :

Pancreas is the only **heterocrine** gland in the human body. It acts as exocrine as well as endocrine gland. It acts as exocrine as it secretes pancreatic juice which is poured into the duodenum with the help of pancreatic duct. The endocrine tissue of the pancreas is in the form of clumps of secretory cells known as the **islets of langerhans**. The islet cells are of three-alpha, beta and delta.

(i) **Insulin** is secreted by the beta cells and like other hormones, passes directly into the blood. Insulin is required to convert glucose into glycogen (**glycogenesis**) and store it in liver. Deficiency of insulin due to defect in islets of Langerhans results in **diabetes mellitus**, a condition in which blood glucose is high and is passed in the urine.

(ii) The alpha cells of pancreas secrete **glucagon**, the metabolic effects of which are opposite to those of insulin. It causes the breakdown of liver glycogen, thereby releasing glucose into the blood stream.

(iii) The third hormone **somatostatin** is secreted by the delta cells of the islets of Langerhans. It is able to inhibit the secretion of many hormones. As it inhibits the release of growth hormone of



pituitary gland, it is also known as growth hormone release inhibiting hormone (GHRH).

### 9.5 (h) Ovaries :

Ovaries secrete three hormones :

**(i) Oestrogen :** FSH from the anterior pituitary controls the secretion of oestrogen by acting on the Graafian follicles. This hormone effects the development of female sex characters. The oestrogen secretion influences the follicular phase. Its secretion is maximum during ovulation period. Moreover during pregnancy the oestrogen secretion by placenta keeps on increasing till full term.

**(ii) Progesterone :** It is secreted by corpus luteum. This hormone in contrast to oestrogen which is produced continuously during the reproductive years, is secreted only after ovulation. Progesterone prepares the uterus for receiving the embryo. It prepares inner lining of the uterus i.e. endometrium to receive the implanted embryo for about a week. If ovum gets fertilized, the corpus luteum continues to play a role in maintaining the pregnancy for the first three months, after which the placenta takes over the role of corpus luteum by secreting progesterone itself. This hormone is essential for the maintenance of pregnancy and is therefore called **pregnancy hormone**. If pregnancy does not follow ovulation, corpus luteum degenerates and breaks down due to the lack of progesterone.

**(iii) Relaxin :** This hormone is secreted during later stage of pregnancy and leads to relaxation of muscles of the pelvic area to enable easy child birth and reduce the pressure on the foetus.

### 9.5 (i) Testes :

Testosterone is the main testicular hormone secreted by interstitial cells of the testis. It is mainly concerned with the development and maintenance of male sex characters and enhancing the process of

spermatogenesis.

## 9.6 NERVOUS CO-ORDINATION IN ANIMALS :

In animals two kinds of co-ordination -nervous & chemical are present. The nervous co-ordination is brought about by the nervous system and the chemical co-ordination by hormones. Both the systems work an integrated system. Infact such a control and coordination requires.

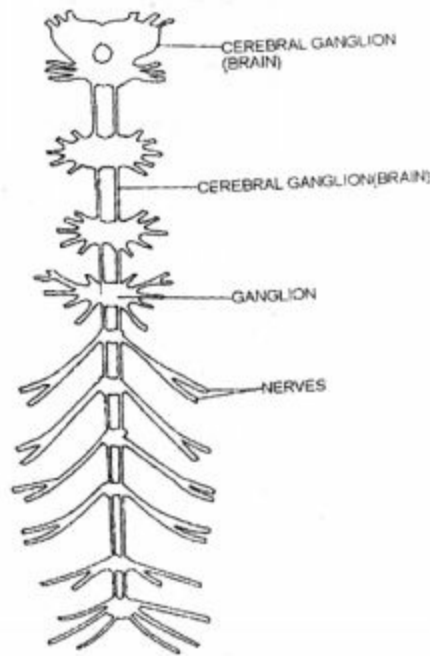
- (i) Gathering information about changes in the external environment.
- (ii) Transmitting this information to the internal cells located away from the body surface and.
- (iii) Exchange of information between the cells situated away from each other

- **Nervous system in animals** : Except, Sponges, all multicellular animals possess simple or complex nervous system. In all these animals, nervous system is comprised of specialized cells called neurons or nerve cells to respond to stimuli and coordinate animal activities. Nerve cells are the structural & Functional units of nervous system.

- **Nervous system of Hydra** : Hydra belongs to phylum Cnidaria (Coelenterate) of the group invertebrate. The nervous system in hydra is merely a network of nerve cells joined to one another and spread throughout the body between the two germ layers, outer epidermis & inner gastrodermis. **This network is called as nerve net.** When the body of hydra receives certain stimulus at a particular region from the environment, the nerve cells present at the region send impulses in all the direction through the network of nerve cells spread throughout the body. In this way, nerve network coordinates responses to different stimuli in Hydra without the existence of central control region i.e. brain.

- **Nervous system in grasshopper (as Insect)** : In insects, the nervous system consists of a brain, ganglia (singular ganglion) & nerve cord. A mass of nerve cells is called ganglion. The nerve cord runs along the entire length of the body. At intervals, it has ganglia. Small nerves are given out from each ganglion. Near the anterior end of the insect body, a large bilobed ganglion, called the brain, is present. Thus the nervous system of grasshopper consists of a brain, a long nerve cord,

the ganglia and nerves spreading form the nerve cord.



**Nervous system of Grass hopper**

## **DAILY PRACTICE PROBLEMS # 9**

### **OBJECTIVE QUESTIONS**

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1. Phytohormones are  
(A) hormones regulating growth from seed to adulthood  
(B) hormones regulating secondary growth  
(C) growth regulators synthesized by plants and influencing physiological processes  
(D) hormones regulating flowering.
2. The natural plant hormones were first isolated from  
(A) cotton fruits, spinach leaves, rice plant (B) avena coleoptiles, fungus gibberella  
(C) corn germ oil, human urine (D) human urine, rice plant.
3. If the tip of a seedling is cut off, growth as well as bending ceases because it hampers  
(A) perception of light stimulus (B) transpiration

(C) respiration      (D) photosynthesis.

4. A plant bends towards the source of light when exposed to the light on only one side. Which of the following is the best explanation of the phenomena ?
- (A) It needs light for photosynthesis  
(B) The apices of their stems are attracted by light  
(C) Some auxin accumulates on the shaded side to induce greater cell elongation on that side  
(D) Light stimulates the cells on the illuminated side to increase in length
5. The movement of plant organs in response to the force of gravity is called
- (A) hydrotropism      (B) geotropism      (C) heliotropism      (D) phototropism
6. A high concentration of synthetic auxins is generally used for
- (A) wee control      (B) enhancing root initiation  
(C) controlling of cell enlargement      (D) preventing the growth of the lateral buds.
7. Gibberellic acid has been successfully employed to induce flowering
- (A) in long day plants under short day conditions      (B) in short day plants under long day conditions  
(C) for some plants      (D) none of the above
8. Cytokinins are known to
- (A) inhibit cytoplasmic movement      (C) help in retention of chlorophyll  
(C) influence water movement      (D) promote abscission layer formation
9. Ethylene is a
- (A) solid hormone      (B) gaseous enzyme      (C) gaseous

hormone (D) liquid gas mixture

10. Pineapple can be made to flower in off season by

- (A) zeatin (B) ethylene (C) temperature (D) short days

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## SUBJECTIVE QUESTIONS

### VERY SHORT ANSWER TYPE QUESTIONS

1. What do you mean by receptors and effectors ? Name the different types of receptors.
2. Define hormones. What do you mean by phytohormones ?
3. What do you mean by tropic and nastic movements ? Give one example of each.
4. What are the functions of nervous system ?
5. What do you mean by photoperiodism ?

### LONG ANSWER TYPE QUESTIONS

6. Describe the forebrain of a mammal.
7. Write a short note on chemical co-ordination in plants.
8. Differentiate between endocrine and exocrine hormones. Write the characteristics of hormones.
9. Mention the effects of sympathetic and parasympathetic nervous system on the following :
  - (i) Heart
  - (ii) Urinary bladder
  - (iii) Eye
  - (iv) Gastric secretions
  - (v) Bronchi
10. Name the different types of hormones secreted by pituitary. Also mention their functions.
11. Draw a diagram of human brain and label the following parts on it :

(i) Cerebrum (ii) Meninges (iii) medulla oblongata (iv)  
Cerebellum

**[CBSE Delhi 2005]**

**12.** Draw a diagram of nervous system in an insect. Label the following parts on it

(i) Brain (ii) Ganglion (iii) Nerve Cord

**13.** Write the functions of hormone 'thyroxine' in our body. **[CBSE Delhi 2004]**

**14.** We suddenly withdraw our hand when a pin pricks. Name the type of response involved in this action.

**[CBSE Delhi 2004]**

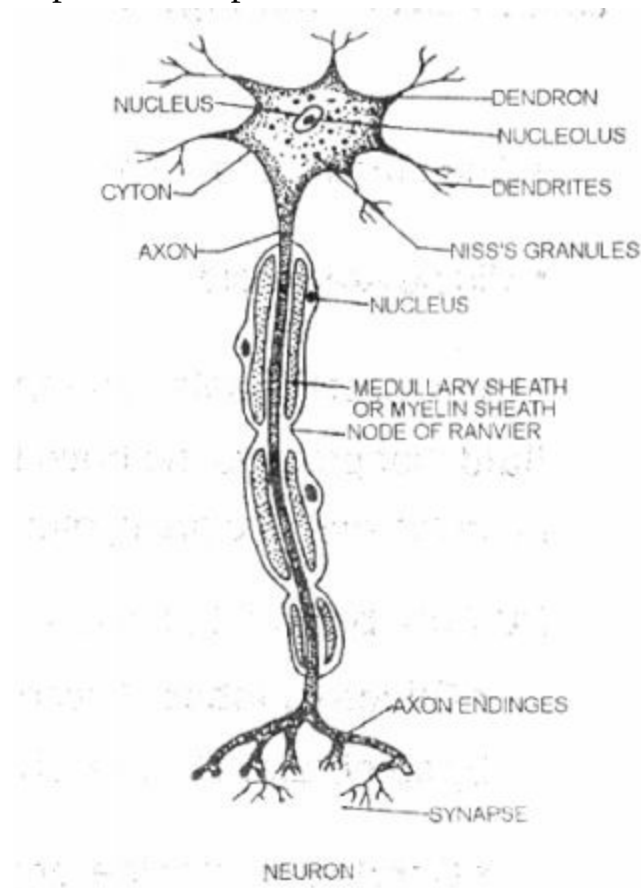
**15.** Name the part of hind brain which takes part in regulation of respiration.

**[CBSE Delhi 2004]**

# CONTROL & CO-ORDINATION

## 10.1 NERVOUS SYSTEM IN HUMAN :

The nervous system of human beings consists of central & peripheral nervous systems. Neuron is the structural & functional unit of nervous system. It is the longest cell found in the body. They unit the receptor and effector organs with each other. The nervous system is composed of neurons. These are surrounded by a connective tissue called neuroglia. Impulses from recptors run through neurons. The number of neurons are almost fixed for a particular species.



### 10.1 (a) Structure :

Each neuron consists of a cell body called cyton and a number of branches (nerve fibres) arising from the cyton. Neuron does not divide. Cyton contains a nucleus within the cytoplasm & Nissl's granules (formed of RER with ribosomes) and fine thread like fibres, called neurofibrils.

**(i) Dendrites :** These are short, several, much branched & contain granules. They carry impulse towards the cyton.

**(ii) Axon :** It is a large, single and unbranched structure. It has not nissl's granules. It carries impulses from cyton to the effector organs like glands, muscles etc. It is a typical nerve fibre consisting of a central thin cytoplasm cylindrical axis continuous with the body. Its cytoplasm is called **axoplasm**. Axis cylinder is enclosed in a thin permeable membrane called **axolemma** or nerve membrane. A layer of fatty material called myelin or medullary sheath is found outside the axolemma. Such fibres are called myelinated (medullated) fibres. They seem to be white. Nerve fibres lacking myelin sheath are called non-myelinated & appear grey in colour. Myelin is interrupted at intervals by circular constrictions called **Nodes of Ranvier**. Terminal branches of axon are called telodendria. Each telodendron ends in a swollen knob called **synaptic knob or terminal button**. Synaptic knob of one nerve fibre (axon) forms synapse with the dendrites of another neuron. Synapse is a very fine gap between two neurons. Thus, in the entire nervous system neurons are linked together.

### 10.1 (b) Types of Neurons or Nerve Fibres :

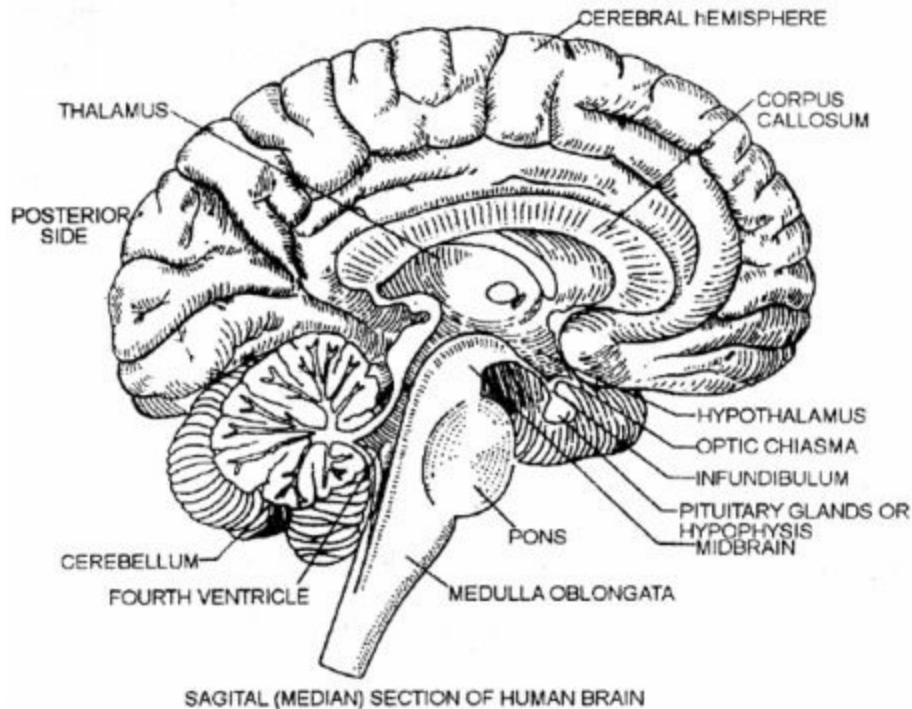
**(i) Motor :** It carries impulses from brain and spinal cord to effector organs.

**(ii) Sensory :** It transmits impulse from sensory organs to central nervous system.



## 10.1 (c) Types of Nervous System :

(i) **Central nervous system** : It consists of the **brain** and the **spinal cord**. The brain is covered by cranium & spinal cord is covered by vertebral column Both are also surrounded by three membranes of the connective tissues called **meninges**.



- Outer most Duramater
- Middle Arachnoid
- Inner most Piamater. The space between the membrane is filled with a fluid called **cerebrospinal fluid** that protect the brain from mechanical shocks. The brain can be differentiated into three main regions fore brain, mid brain & hind brain.

(A) **Fore brain** : It consists of olfactory lobes, cerebrum and diencephalon.

- **Olfactory lobes** : These are a pair of small, solid, cube shaped bodies. They are fully covered by cerebrum. They receive impulse for smell.

• **Cerebrum** : It is the largest part of the brain. It consists of two cerebral hemispheres joined by a band of nerve fibres called corpus callosum. Surface of cerebral hemisphere is made up of gray matter, called cerebral cortex. It becomes highly folded to increase area for accommodation of more neurons. The folds are called gyri & depression between them, are called sulci. Deep and wide sulci are called fissures. Fissures divide each cerebral hemisphere into four lobes

(i) Occipital lobe : Region for visual perception

(ii) Frontal lobe : For muscular activities

(iii) Parietal lobe : For touch, smell, temperature and conscious association.

(iv) Temporal lobe : For auditory reception

Cerebrum has sensory areas where impulses are received from sense organs (receptors). Similarly it has a general motor area from where impulses are sent to effector organs (Muscles & glands)

• **Diencephalon** : It encloses a cavity called third ventricle. It consists of thalamus and hypothalamus. Thalamus serves as a relay centre for sensory and motor impulses from spinal cord and medulla oblongata to cerebrum. It recognizes sensory impulses of heat, cold, pain, light & pressure. Floor of third ventricle is called hypothalamus. It possesses control centres for hunger, thirst, thermoregulation, sleep, sex, stress etc.

**(B) Mid Brain** : It consists of two heavy fibre called **Crura cerebri**. These tracts connect fore brain to the hind brain. These are the centres for control of eye movement and hearing responses.

**(C) Hind brain** :

• **Cerebellum** : Very large & well developed. It controls coordination and adjustment of movements (equilibrium) and posture.

- **Pons varolii** : it lies above the medulla oblongata. It controls some aspects of respiration.

- **Medulla oblongata** : It is the posterior most part of the brain and continues into the spinal cord. It controls involuntary functions of the body such as heart beat, rate of breathing, secretion of saliva, swallowing, coughing, sneezing, vomiting etc.

- **Spinal Cord** : It lies in the vertebral column. It starts from medulla oblongata and extends downward. It is also protected by three meninges and cerebrospinal fluid. It also acts as a centre for spinal reflexes.

**(ii) Peripheral nervous system** : It included cranial nerves and spinal nerves. It mainly controls the voluntary activities of the body. Cranial nerves also called cerebral nerves arise from brain. There are 12 pairs of cranial nerves in man and 31 pairs of spinal nerves arise from spinal cord.

**(iii) Autonomic nervous system** : It controls Involuntary activities of internal organs such as hear, blood vessels, glands & smooth muscles of alimentary canal & uterus. It is subdivided into

- Sympathetic
- Parasympathetic system.

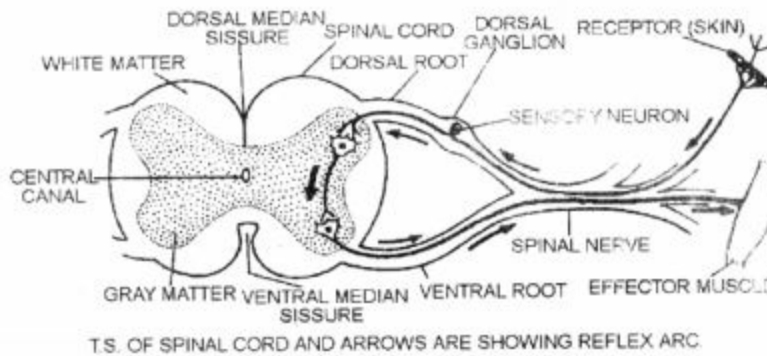
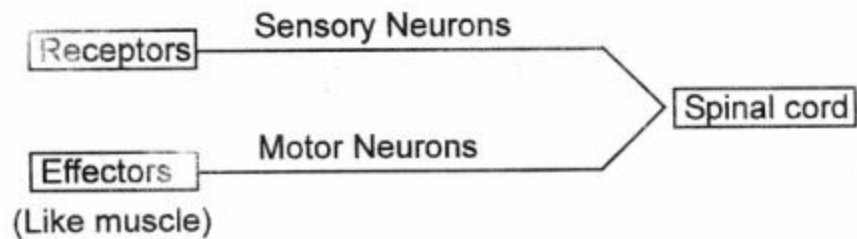
Organs receive nerves from both sympathetic and parasympathetic nerve fibres. They have opposite effects on the organs if one is stimulatory, the other is inhibitory.

### 10.1 (d) Effect of Sympathetic and Parasympathetic System :

Organ	Sympathetic System	Parasympathetic system
Heart	Increase heart beat	Decreases heart beat
Blood vessels	Constricts arteries & raises blood pressure.	Dilates arteries & lowers blood pressure
Brochi	Dilates bronchi making breathing easier	Constricts bronchi
Eye	Dilates pupil	Constricts pupil

Gastric secretion	Inhibits secretion	Stimulates secretion
Salivary glands	Inhibits secretion of saliva	Stimulates secretion
Urinary bladder	Relaxes urinary bladder	Contracts urinary bladder
Liver	Reduces bile secretion	Promotes bile secretion.

### 10.1 (e) Reflex Action :



Reflex action is the name given to the response which is at the level is spinal cord itself. It is a rapid automatic response to a stimulus by an organ or a system of organs, which does not involve the brain for its initiation. A reflex action is an unconscious (without will) and involuntary response of effectors (muscles or glands) to a stimulus.\

### 10.1 (f) Reflexes are of Two Types :

Simple or unconditioned and continued reflexes.

**(i) Simple reflex :** It is an inborn response to a stimulus. Where learning is not required. These are mostly protective in function **e.g.** knee jerk occurred immediately when patella tendon of leg is sharply

tapped, quick closing of eyelid when an object suddenly comes in front of eyes (corneal reflex) etc.

**(ii) Conditioned reflex :** These are not inborn. They are acquired by experience, training & learning. **e.g. Learning of cycling or driving of scooter etc.**

### 10.1 (g) Electro Encephalogram (EEG) :

An instrument called electro encephalograph can record electrical activity of brain. The activity of brain is recorded as electrical potentials such a record is called Electro Encephalogram. By placing two electrodes on the scalp and leading via suitable amplifier to ink writing device, record of four different types of waves is obtained. These waves are named as alpha, beta, delta and theta and vary in frequency. These waves give the characteristic activity of brain which is very useful for clinical purposes.

## DAILY PRACTICE PROBLEMS # 10

### OBJECTIVE QUESTIONS

1. The effect of daily light period on flowering is called  
(A) photooxidation (B) phototropism (C) photoperiodism (D) photorespiration
2. Brain stem is formed by the union of  
(A) optic lobes (B) cerebellum with optic lobes  
(C) corpora striata (D) mid brain, ponsvarolli and medulla oblongata
3. Number of spinal nerves in man are  
(A) 11 pairs (B) 13 pairs (C) 6 pairs (D) 31 pairs

4. Third ventricle occurs in  
(A) cerebrum (B) cerebellum (C) medulla oblongata (D) diencephalon
5. The pineal body is considered as  
(A) an endocrine gland (B) an organ concerned with voluntary actions  
(C) an organ concerned with vision (D) a vestige of third eye and endocrine gland
6. Part of brain involved in interpretation, storage of information and initiation of response on the basis of past experience is  
(A) motor area (B) cerebellum (C) sensory area  
(D) association area
7. Autonomic nervous system controls  
(A) reflex action (B) sense organs (C) internal organs  
(D) skeletal muscle
8. The study of nervous system and its disorders is called  
(A) neurogenesis (B) hematology (C) neuroglia (D) neurology
9. In reflex action the reflex arc is formed by  
(A) brain → spinal cord → muscles (B) receptor → spinal cord → muscles  
(C) muscle → receptor → brain (D) muscles → spinal cord → receptor
10. The sensation of sight in human brain is perceived by  
(A) optic lobe (B) occipital lobe (C) frontal lobe  
(D) parietal lobe

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## SUBJECTIVE QUESTIONS

### VERY SHORT ANSWER TYPE QUESTIONS

1. Systematically represent the path of a reflex action. From where it is

controlled ?

2. What are the functions of the following endocrine glands?

(i) Pancreas (ii) Thyroid (iii) Adrenal (iv) Ovaries (v) Testes

3. Name the parts of endocrine system called as super master and master, also write their functions.

4. Write a short note on electroencephalography (EEG).

5. Write a short note on forebrain ?

6. Distinguish between cerebrum & cerebellum.

7. What are the functions of hindbrain ?

## **LONG ANSWER TYPE QUESTIONS**

8. Write a short note on nerves. Also write about the different types of nerves found in human body.

9. What is hypothalamus ? Where it is situated? What are its main functions and secretions ?

10. Describe the structure of neuron with the help of a well labelled diagram.

11. Write down the source, site of action and functions of the following.

(i) Auxins (ii) Progesterone (iii) Thyroxin (iv) Ethylene (v) Insulin

12. Write a short note on secretory nature of.

(i) Pancreas (ii) Liver (iii) Testes (iv) Ovaries (v) Adrenals

13. Define 'nerve impulse'. Which structure in neuron helps to conduct a nerve impulse ?

(i) Towards the cell body (ii) Away from the cell body **[CBSE, 2004]**

14. Which hormone is responsible for the development of moustache and beard in men. [CBSE, 2004]

15. What is the difference between sensory and motor neurons. Which parts of human brain are responsible for auditory reception and sensation of smell ?

16. Which type of glands in human body secrete hormone ? State any one location for them. [CBSE, 2004]

## ANSWERS

### DAILY PRACTICE PROBLESM # 9

Qus.	1	2	3	4	5	6	7	8	9	10
Ans.	C	B	A	C	B	A	A	B	C	B

### DAILY PRACTICE PROBLESM # 10

Qus.	1	2	3	4	5	6	7	8	9	10
Ans.	C	D	D	D	D	D	C	D	B	B

# REPRODUCTION

## 11.1 MEANING OF REPRODUCTION :

Reproduction is the ability of living organisms to produce new living organisms similar to them. It is one of the important characteristic of



life.

### **11.1 (a) Purpose of Reproduction :**

Reproduction is aimed at multiplication and perpetuation (stability) of the species. In other words it proves group immortality by replacing the dead individuals with new ones.

### **11.1 (b) Basic Features of Reproduction :**

The modes of reproduction vary in different organisms. However all of these have certain common basic features. These are -

- (i) replication of DNA      (ii) cell division
- (iii) Formation of reproductive bodies or units      (iv) development of reproductive bodies into offspring

## **11.2 FORMS OF REPRODUCTION :**

Animals reproduce in a variety of ways. Which are categorized in two categories i.e. Asexual and sexual reproduction.

### **11.2 (a) Asexual Reproduction :**

**Definition :** Production of offspring by a single parent without the formation and fusion of gametes is called as **asexual reproduction**. It is more primitive type of reproduction. It ensures rapid increase in number.

**Occurrence :** Asexual reproduction occurs in protozoans and some animals such as sponges, coelenterates, certain worms and tunicates. It is absent among the higher invertebrates and all vertebrates.

**Type of Asexual Reproduction:** Asexual reproduction takes place in the following principal ways :

**(i) Fission :** it is the simplest form of reproduction in which unicellular organism either divides into two or many organisms.

• **It is also divided into two types :**

**(A) Binary fission :** It is a type of reproduction in which nuclear division is followed by the appearance of a constriction in the cell membrane, which gradually deepens inward and divides the

cytoplasm into two parts, each with one nucleus. Finally two daughter cells are formed.

**e.g. Amoeba**

**(B) Multiple fission :** Sometimes the nucleus several times into many daughter nuclei. The daughter nuclei arrange at the periphery of the parent cell, and a bit of cytoplasm around each daughter nuclei is present. nucleus develops an outer membrane. Finally the multinucleated body divides into many daughter cells. **e.g. Plasmodium.**

**(ii) Budding :** Formation of daughter individual from a small projection which is called as bud, arising on the parent body is called as budding.

**Budding is also of two types :**

**(A) Exogenous budding :** [External budding] In this, bud arises from the surface of parent body, **e.g., Hydra.**

**(B) Endogenous budding :** [Internal budding] In this, bud arises inside or within the parent body **e.g., Sponges.**

**NOTE :** During the process of budding, the bud remains attached to the parent body so as to derive its nutrition from the parent but as it matures, it gets detached from the parent body.

**(iii) Fragmentation :** It is a type reproduction or the regeneration ability of the organisms to replace their lost part. In this process an entire new organism can grow from certain pieces or cells of the parent organisms. **e.g. Flatworm.**

**(iv) Spore formation :** It is a process of reproduction most commonly found in fungi, some cocci and bacillus bacteria. During this process a structure called as **sporangium** is formed. In this structure nucleus divides several times and each nucleus with a little trace of cytoplasm forms a **spore. These** spores are then liberated out and develop into a new hyphen, e.g. **Rhizopus.**

**(v) Vegetative propagation :** This is a type of reproduction found in higher plants in which a new plant is formed from vegetative part of the plant such as roots, stems or leaves.

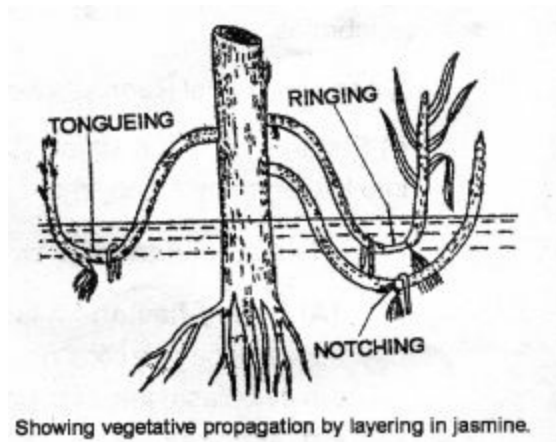
### **It is of following types :**

**(A) Cutting :** This is the very common method of vegetative propagation practised by the gardeners all over the world. It is the process in which a vegetative portion from plant is taken and is rooted in the soil to form a new plant **e.g. Grapes, Sugarcane** etc.

**(B) Layering :** In this process the development of adventitious roots is induced on a stem before it gets detached from parent plant, e.g, Mango, **roses** etc.

### **It is of three types :**

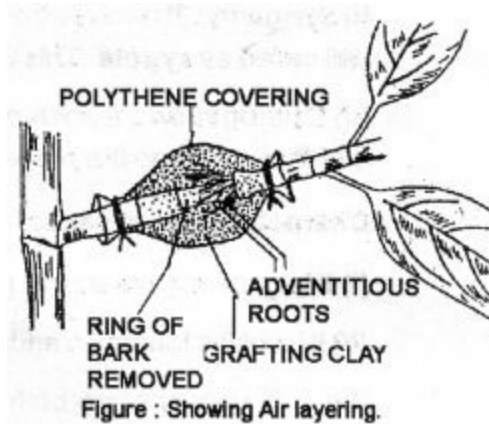
- **Mound layering :** In the process of layering the lower stem branch of plant is used. Leaves are removed from this stem. Then it is bent close to the ground, pegged and covered with the moist soil in such a way that it's rowing tip remains above the solid surface. This pegged down branch is called as **layer**. After a few days the covered portion of stem develops roots. This stem is then detached from the parent plant and is grown separately from the parent plant and is grown separately into a new individual **.e.g Jasmine**



**NOTE :** The formation of adventitious roots in a layer can be hastened by injuring the 'layer' by tonguing, ringing or notching.

- **Air layering :** It is adopted in those plans where stem cannot be bent to the ground. In this process the stem is **girdled** (i.e. ring of the bark is removed). then it is covered with moist moss or cotton and wrapped with a polythene sheet to preserve the moisture. After few

weeks adventitious roots develop from the injured part. The branch along with roots is then separated from the parent plant and planted to grow into a new plant. **e.g. Orange, Pomegranate** etc.



- **Grafting** : The process of joining together of two different plants in such a manner that they live as one plant is called as **grafting**. Out of the two plants one is rooted in the soil and is known as the **stock**. The other part consists of a small shoot bearing one or more buds, it is known as **scion**. Their union is carried out in such a way that their cambium must overlap each other **e.g. Mango, roses** etc.

(vi) **Micro propagation** : It has now become possible due to recent techniques to produce a large number of plantlets from a small piece of tissue taken from the shoot tip or other suitable plant parts. This method of propagation is called as **micropropagation**. It involves the process of **tissue culture**. **e.g., Orchids, ornamental plants** etc.

- **Significance of vegetative propagation**

(A) It is used to propagate a plant in which viable seeds are not formed or very few seeds are produced **e.g. Orange, pineapple, banana** etc.

(B) Vegetative propagation helps us to introduce plants in new areas where the seed germination fails to produce mature plant due to change in environmental factors and the soil.

(C) Vegetative propagation is a more rapid, easier and

cheaper method of multiplication of plants.

(D) By this method a good quality of a race or variety can be preserved.

(E) Most of the ornamental plants are propagated through vegetative propagation. **e.g. Rose, Tulip** etc.

**(vii) Parthenogenesis** : It is a modification of sexual reproduction in which an egg develops into a

complete offspring without fertilization. It is monoparental (i.e. fusion of gametes does not occur, only a single parent gives rise to a new individual).

- **Significance of asexual reproduction** : It brings about multiplication of the species only. It does not play a role in evolution as no variation is introduced into the new individual formed by it.

## 11.2 (b) Sexual Reproduction :

- **Definition** : Production of offspring by formation and fusion of special haploid cells called as gametes. These are contributed generally by two parents. i.e. ,**male gamete** and **female gamete** is called as **sexual reproduction**.

- **Occurrence**: Sexual reproduction occurs nearly in all animals including those which reproduce asexually. In most animals there are two sexes male and female, and the differences between them are genetically determined.

- **Types of sexual reproduction** :

**(i) Syngamy** : It involves the complete and permanent fusion of two gametes to form a composite cell called as **zygote**. This is a common mode of sexual reproduction.

**(ii) Conjugation** : It involved temporary pairing of two parents which exchange their pronuclei and then undergo the process of separation .**e.g Paramecium** etc.

- **Characteristics of sexual reproduction** :

(i) It is generally biparental [i.e. it involves two parents ]

- (ii) It involves formation and fusion of gametes.
- (iii) Cell divisions are both **meiotic & mitotic** during gamete formation and **mitotic** during development of zygote into an offspring.
- (iv) The offspring's are not genetically identical to the parents.
- (v) Fertilization in case of humans is internal.
- (vi) Infants can be fed on mother's milk.
- (vii) Parental care is very well developed,

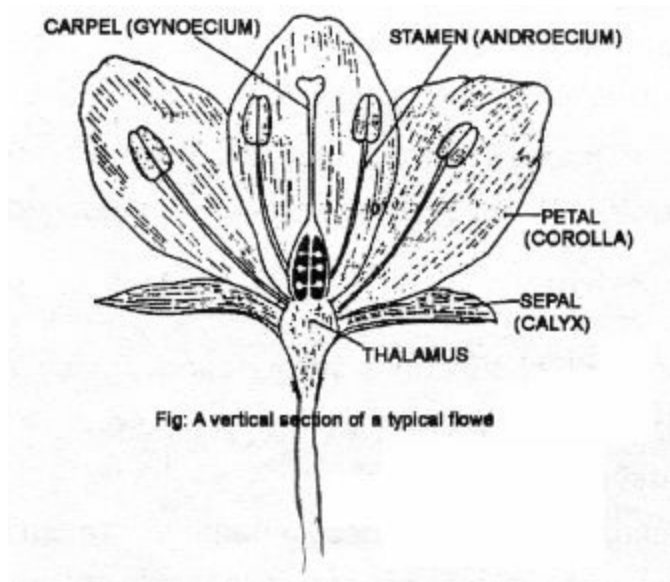
• **Significance of sexual reproduction :**

- (i) It results in multiplication and perpetuation of species.
- (ii) It contributes to evolution of the species by introducing variation in a population much more rapidly than asexual reproduction.

• **General Terms :**

- (i) **Fertilization** : It is the process of fusion of gametes.
- (ii) **Unisexual organism** : In case of humans male and female sex organs are separate and therefore called as unisexual.
- (iii) **Bisexual** : In plants and some organisms like tapeworm, earthworm etc. both male and female organs are present in the same individual and therefore called as bisexual.
- (iv) **Gonads**: Organs which are involved in the formation of gametes are called as gonads.
- (v) **Copulation or mating** : The process of transfer of male gametes into female body.

### **11.3 REPRODUCTION IN A FLOWERING PLANT :**



### 11.3 (a) A flower Consists of Following Parts :

(i) **Calyx:** The sepals collectively are called as calyx. They are usually green in colour and protect the inner whorls of a flower especially during bud formation.

(ii) **Corolla :** It consists of coloured petals. They are normally large often fragrant and bright coloured. Their primary function is to attract animals and insects for pollination.

(iii) **Androecium / stamen/male reproductive organ :** The stamens are referred to as the male reproductive organ. A typical stamen is differentiated into three parts, they are **filament connective** and **anther**.

**(A) Filament :** It forms the stalk that bears more or less cylindrical or avoid anther.

**(B) Connective :** It connects anther to filament.

**(C) Anther :** It is present on the top of filament. Each anther consists of two lobes that is why it is called as bilobed. Bed anther lobe has **two pollen sacs** which contain millions of tiny microscopic grains, called as **microspores**. The pollen grains are like yellow dusty powder in appearance.

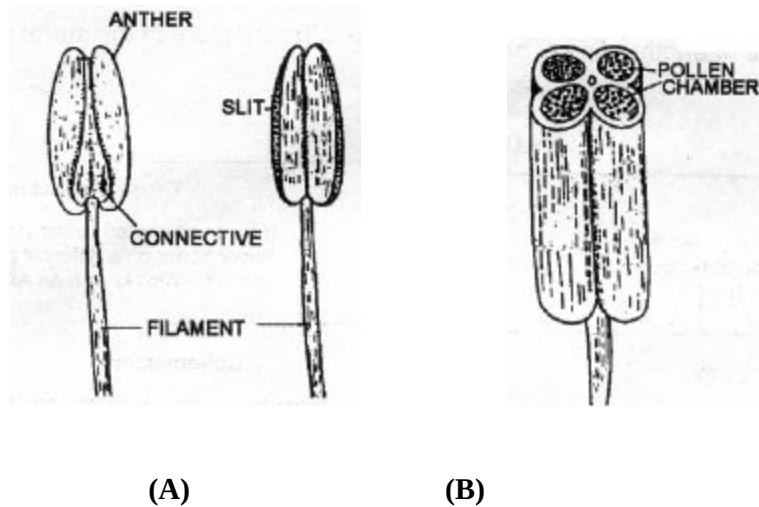


Fig. : (A) ventral view showing connective fanther showing pollen chambers (B) dorsal view (C) t.s. of

### (vi) Gynoecium / pistil / female reproductive organ :

- It is located in the center of a flower.
- It is composed of one or more carpals.
- The freely occurring units of the carpals in a flower are called **pistils**.
- Each pistil usually consist of three distinct parts - ovary, style and stigma.

**(A) Ovary :** It is a basal, swollen part of the pistil The ovary has one or more chambers called the **loculi** which is distributed in a special cushion like parenchymatous tissue called the **placenta**, from which the ovule develops.

**(B) Style :** From the top of the ovary arises a long, elongated structure called as **style**.

**(C) Stigma :** The terminal end of style is called as **stigma**. The stigma is normally rough, hairy or sticky to hold pollen grains during pollination process.

### 11.3 (b) Pollination :



The transfer and deposition of pollen grains from the anther to the stigma of a flower is called as pollination.

• **Types of pollination** : Pollination is of two type -

**(i) self pollination** : It is the process of transfer of the pollen grains from the anther to the stigma of either the same or genetically similar flower. It is further divided into two types :

**(A) Autogamy**: It is a type of self pollination in which the pollen grains are transferred from the anther to stigma of the same flower  
**e.g. Wheat, rice pea** etc.

**(B) Geitonogamy** : It is a type of self pollination in which the pollen grains are transferred from the anthers of one flower to the stigma of another flower borne either on the same plant or a genetically identical plant.

• **Significance of self pollination** :

- It maintains purity of race.
- It also maintains the superiority of variety once developed.

**(ii) Cross pollination** : it is the process of transfer of the pollen grains from the anther of one flower to the stigma of another flower borne on a different plant of the same species.

## POLLINATION

**Fig : Flow diagram showing the types of pollination**

- The transfer of pollen grains occurs through various ways, which may be **biotic** or **abiotic**.

**(i) Abiotic factors                      Technical terms**

Wind	Anemophily
Water	Hydrophily

**(ii) Biotic factors**

Insects	Entomophily
Birds	Ornithophily
Bats	Chiropterophily
Snails	Malacophily.

- **Significance of cross pollination :**

- (i)** Increase in yield and adaptability.

- (ii)** It eliminates defective traits and produces new varieties.

- (iii)** It also leads to the hybrid production.

### **11.3 (c) Fertilization in a Flowering Plant :**

- Fertilization is a process of fusion of male gamete with the female gamete.

- The process of formation of male gametophyte in case of plants is called as **microsporogenesis**.

- The process of formation of female gametophyte in case of plants is called as **megasporogenesis**.

- The process of pollination occurs, due to which the anther get stuck up to the stigma.
- After reaching to stigma pollen grains develops a pollen tube.
- This pollen tube grown through the length of style, from where it reaches to ovule.
  - Pollen tube comprise of two male gametes, which is later on released in the **embryo sac** through an opening called as **micropyle**.
  - Here one male gamete fuses with the egg to form a **diploid zygote** and the other male gamete fuses with the polar bodies to form a **triploid nucleus** which later on produces the structure called as **endosperm**.
  - The process of fusion of one of the male gamete with egg and the other male gamete with polar bodies is called as “**double fertilization.**”
  - The fusion of one male gamete with the two polar bodies to form endosperm is called a “**triple fusion**” (at it involves **one male gamete and two polar bodies**).

**NOTE :** The endosperm is meant to provide nourishment to the developing embryo.

- After fertilization sepals and petals fall and zygote undergoes a series of mitotic division to form a multinuclear embryo.
  - At maturity wall of ovules changes to **seed coat** of which outer one is hard and is known as **testa**, while inner one is called as **tegnum**.

- Ovule change into seed and ovary wall change into fruit wall.

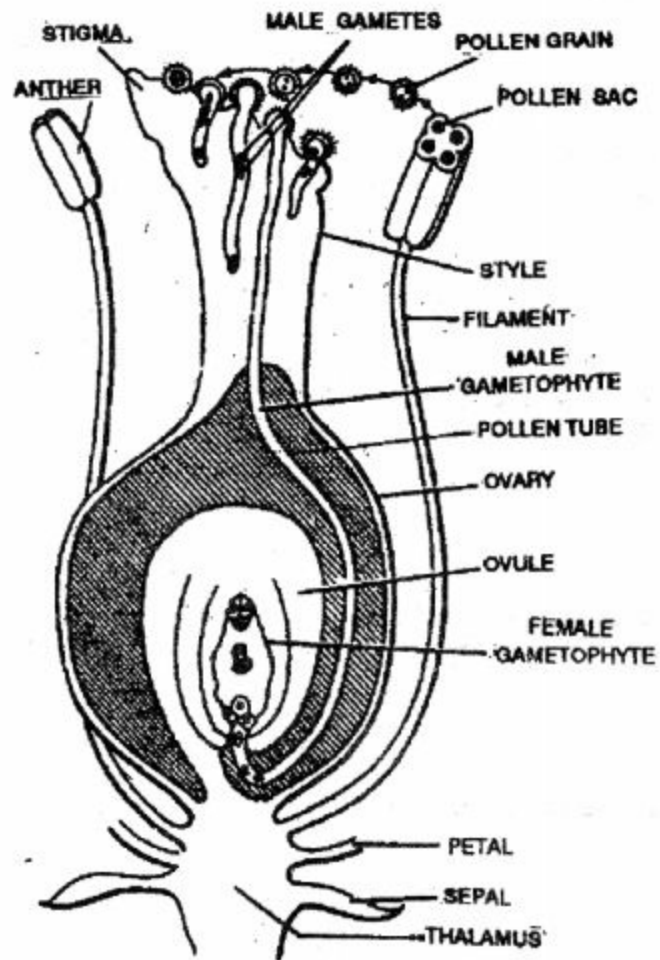


FIG: SHOWING FERTILIZATION IN A FLOWER

## DIFFERENCES BETWEEN SELF POLLINATION AND CROSS POLLINATION

S.NO.	SELF POLLINATION	CROSS POLLINATION
1.	Pollen grains are transferred from the anther to the stigma of the same flower (autogamy) or another flower on the same plant (geitonogamy)	Pollen grains are transferred from the anther of one flower to the stigma of another flower borne on a different plant of the same species (allogamy).
2.	Both the anther and stigma mature at the same time.	The anther and stigma of a flower generally mature at different times.
3.	It can occur even when the flowers are closed	It occurs only when the flowers are open.
4.	External agent is not required for self-pollination.	An external agent abiotic or biotic, is essential for cross-pollination
5.	It is economical for the plant.	Cross-pollination is not economical at the plant has to produce a lot of pollen grains, nectar, scent and bright-coloured corollas etc.
6.	Self-pollination ultimately results in progenies which are pure lines i.e. homozygous.	Cross-pollination produces the offspring which as hybrids i.e., heterozygous. They show variations in characteristics.

7.	In cannot eliminate useless or harmful characters.	It can eliminate useless or harmful characters.
8.	Highly useful characters get preserved in the race.	Useful characters cannot be preserved in the progenies.
9.	Self-pollination does not introduce any variations and hence the offspring are unable to adapt to the changed environment.	Cross-pollination introduce variations in the offsprings. These variations make these plants to adapt better to the changed environment for the struggle for existence.
10.	Immunity of the race towards disease falls in the succeeding progenies.	Immunity of the race towards disease is usually marinated in the succeeding progenies.
11.	Yield of the plant gradually falls with time.	Yield of the plant usually does not fall.
12.	Self-pollination never helps in the production of new varieties and species.	Cross-pollination is a mechanism of roducing new varieties and species among plants.

## DAILY PRACTICE PROBLEMS # 11

### OBJECTIVE QUESTIONS

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1. Cleistogamous condition is present in  
(A) Brassica oleracea      (B) Solanum tuberosum      (C) Arachis hypogea  
(D) Allium cepa
2. Which of the following regenerated with the help of layering?  
(A) Cactus      (B) Rose      (C) Mango      (D) Jasmine
3. Development of egg without fertilization is  
(A) parthenocarpy      (B) polyembryo  
(C) parthenogenesis      (D) adventive embryony
4. Anemophily is pollination by  
(A) air      (B) water      (C) insects      (D) animal
5. Pollination between different flowers of same plant is called  
(A) autogamy      (B) geitonogamy      (C) allogamy  
(D) xenogamy
6. Double fertilization is  
(A) fusion of two male gametes with egg  
(B) fusion of one male gamete with egg and the other male gamete with the polar bodies  
(C) both are correct  
(D) both are incorrect
7. The structure meant for the nourishment of developing embryo in case

of plant is

- (A) pollen tube                      (B) endosperm  
(C) both A & B are correct              (D) none of these

**8.** The embryo sac of a typical dicot at the time of fertilization is -

- (A) 8 celled                      (B) 7 celled                      (C) 6 celled                      (D) 5 celled

**9.** The genetic information is stored in -

- (A) DNA                      (B) RNA                      (C) Ribosome                      (D) ER

**10.** Each female flower consist of

- (A) ovary                      (B) stigma  
(C) ovary, style and stigma                      (D) thalamus



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## **SUBJECTIVE QUESTIONS**

### **VERY SHORT ANSWER TYPE QUESTIONS**

1. What is reproduction ?
2. What is the basic requirement of sexual reproduction ?
3. What is the difference between binary and multiple fission ?
4. What is a spore ?

### **LONG ANSWER TYPE QUESTIONS**

6. What is budding ? mention it's types.
7. What are accessory sex organs ?
8. What is gonad and what are it's functions ?
9. Define implantation.
10. Differentiate between vas deferens and vasa efferentia.

# REPRODUCTION

## BL-12

### 12.1 SEXUAL REPRODUCTION IN HUMANS :

- Mammals are unisexual.
- Reproductive system of each organism consists of many reproductive organs.
  - These can be primary sex organs or secondary sex organs.
    - The **primary sex organs** are called as **gonads**. They produce sex cells or **gametes** and also secrete sex hormones.
    - The gonads of males are called a **testis**, which produce **sperms**.
    - The gonads of females are called as **ovaries**, which produce **ova or female gametes**.
      - **Secondary sex organs** include the reproductive ducts which transport gametes and reproductive glands which help in process of reproduction. These organs do not produce gametes.

- **e.g., In males** : Vasa efferentia, epididymis, seminal vesicles, ejaculatory duct, urethra etc. **In females** : Fallopian tube, uterus, vagina, mammary glands etc.

- **Accessory or external sex characters** help to distinguish the two sexes of a species externally.

- **e.g., In male** : Muscular body, more height, low pitched voice, moustaches etc.

**In female** : High pitched voice, breast development, lateral pubic hairs etc.

- **Puberty** : Beginning of sexual maturity is known as **puberty**.

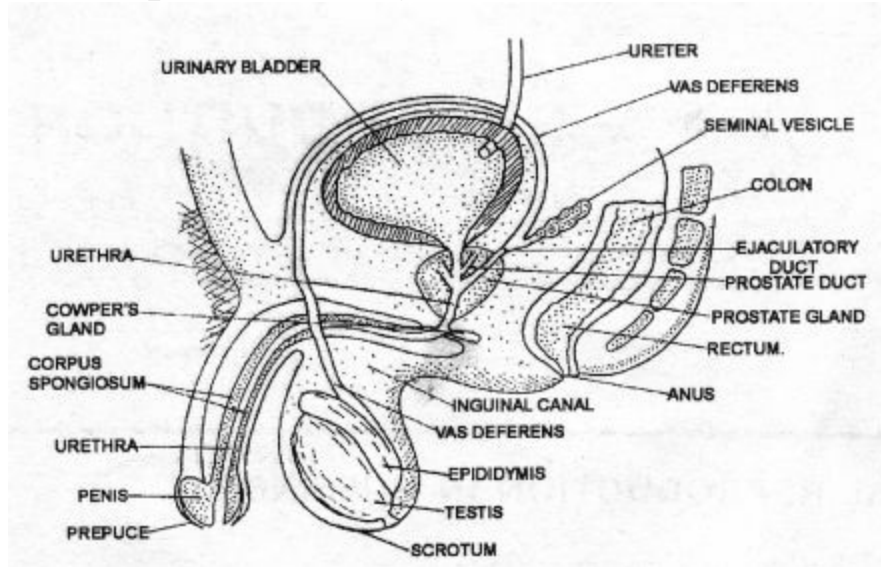
- At this stage primary sex organs start functioning.

- Secondary sex organs develop fully under the influence of sex hormones produced by primary sex organs.

- In the stage of puberty body growth is very rapid.

- It occurs at the age of **10 - 14 years in girls** and **13 - 15 years in boys**.

## 12.1 (a) Male Reproductive System :



**Fig : Male reproductive system.**

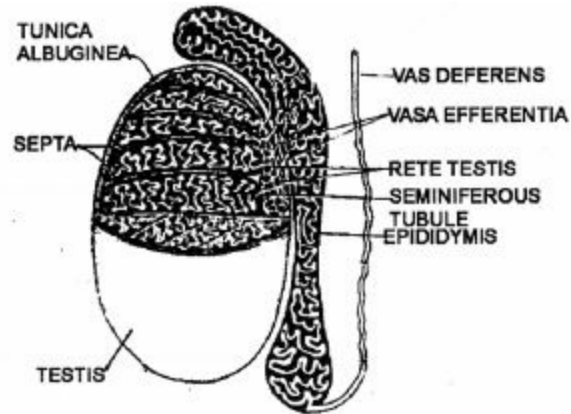
- **Male reproductive system comprises of following parts :**

- (i) Testis            (ii) Scrotum            (iii) Vasa efferent
- (iv) Epididymis            (v) Vas deference            (vi) Ejaculatory
- (vii) Urethra            (viii) Accessory sex glands            (ix) Penis

duct

- (i) **Testis :**

- They are soft, smooth, pinkish, oval organs. They are housed [present] in a sac like structure called as **scrotum**. **Outer** covering is called as **as tunica vaginalis**.
- It's inner covering is called as **tunica albuginea**.
- Ingrowths of tunica albuginea are called as **septa**, that divide the testis into 200-300 lobules.



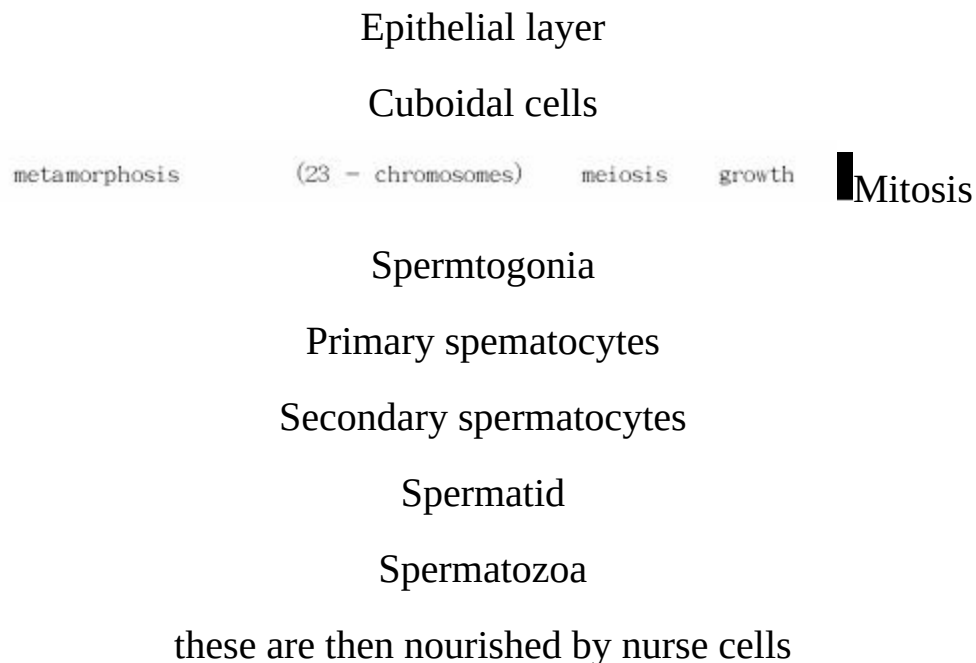
**Fig : Longitudinal section of mammalian testis .**

- It also consist of convoluted somniferous tubules.
- These somniferous tubules at one end join to form tubules which open into a network of irregular cavities known as **rete testis**.
- This rete testis comes out from a dorsal surface of the testis with the help of **vesa efferentia**.

This vasa efferentia combines to form a single tube which becomes highly coiled and from **epididymis**.

- This vasa efferentia combines to form a single tube which becomes highly coiled and form **epididymis**.

- Epididymis peon into a narrow tube **vas deferens**.
- **Somniferous tubules** from the spermatogenic tissue of the testis.
  - It consists of a germinal epithelial layer at the periphery. Spermatogenesis occurs at the center.
  - It forms spermatogonia which grows and form spermatocytes which further grow to form **primary spematocytes**, which undergo meiosis to form **secondary spermatocytes** and then **spematids**.
    - The later (i.e. spermatids) metamorphose into **spermatozoa**.
    - This process of formation of spermatozoa from spermatogonia is called as **spermatogenesis**.
    - These spermatozoa are nourished during the development by nurse cells.



**Flow chart showing the process of Spermatogenesis**

- In between somniferous tubules, there are interstitial cells known as **Leydig cells** which secrete male hormone called as **testosterone**. **This** hormone helps in the growth and development of male sex hormone.

**(ii) Scrotum** : It is a pouch of pigmented skin arising from the lower abdominal wall and hanging between the legs.

- It is divided internally into two compartments by a muscular partition called as **septum scroti**.

- Scrotum possesses smooth involuntary **dortus muscles**.

- Scrotum sac is connected to the abdominal cavity through **inguinal canal**.

- Function of dortus muscle is to change the position of testis to keep them at proper temperature.

- Scrotum has temperature 1 - 3 lower than body temperature which favours the formation of sperms.

- **Duct system** :

**(iii) Vasa efferentia** : Rete testis is connected to epididymis through a fine tubule called as **vasa efferentia**. They help in conduction of sperms.

**(iv) Epididymis** : They are long tubules which lie compacted along the testis from their upper ends to lower back side. Its walls are muscular and glandular to provide or secrete nutritive fluid which provides nourishment to the sperms.

**(v) Vas deference** :

- Vasa efferentia from epididymal duct finally opens into vas deferens.

- It comes out through inguinal canal passing over urinary bladder to receive ducts from seminal vesicles.

- They are thick walled and muscular and conduct sperms.

**(vi) Ejaculatory duct** : They are short, straight, muscular tubes, each formed by the union of vas deferens and duct of seminal vesicles.

**(vii) Urethra** : it arises from urinary bladder forming a urinogenital canal. It carries urine, sperm and secretion of seminal vesicles, prostate and Cowper's gland.

**(vii) Accessory glands:** They consist of prostate gland, a pair of seminal vesicles, and a pair of Cowper's gland.

**(A) Prostate gland :** It is a large pyramidal gland that encloses a part of urethra including its junction with the ejaculatory duct. It contains 30 - 40 alveoli which open separately into urethra by fine ducts. Secretion is thick, milky and alkaline which constitute 20 - 30% semen.

**(B) Cowper's glands** “ These are a pair of small glands, present below the prostate and consist of separate opening. Their secretion provide lubrication to the reproductive track.

**(C) Seminal vesicle :** It is paired and present between urinary bladder and rectum. Its secretion form a major part of semen (60-70%). It is thick, viscous, alkaline having proteins, fructose and prostaglandins.

**(ix) Penis :** It is a male copulatory organ which also passes urine. It consists of highly sensitive covering of skin called **prepuce**.

### 12.1 (b) Semen :

it is milky, viscous and alkaline fluid, ejaculated by reproductive system of males during copulation

- Its quantity is 2.5 - 4.0 ml at a time having about 40 million sperms.
- Semen has chemical for nourishment of sperms neutralizing the acidity of urethra and vagina, stimulating their movement in female tract.

• **Spermatogenesis** starts at puberty under the influence of **gonadotropin** secreted from **anterior pituitary gland**.

### 12.1 (c) Structure of Sperm :

Each sperm consists of following parts :

(i) Head (ii) Neck (iii) Middle piece (iv) Tail

**(i) Head :** It is oval in structure. It is composed of a large nucleus and a small **acrosome**. The nucleus is compact. It consists of DNA and basic

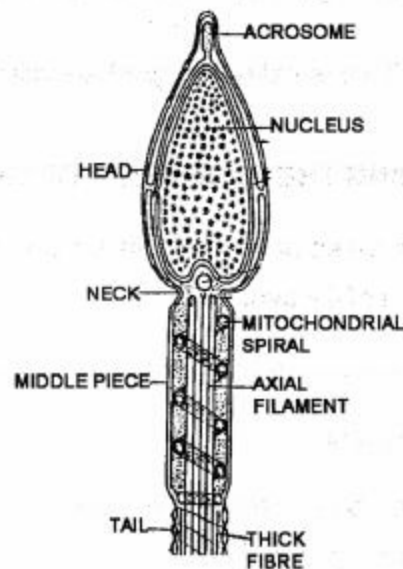


proteins. Acrosome lies at the tip of nucleus. It is formed of golgi complex. It consist of hydrolytic enzymes and is used to contact and penetrate the egg during fertilization.

**(ii) Middle piece:** It is cylindrical in human sperms. It consists of ATP and mitochondria in a thin layer of cytoplasm. Mitochondria is coiled round the axial filament, it provided energy and it is said to be the **power house of the sperm.**

**(iii) Neck :** It is very short and constrains two centrioles. These play an important role during the first cleavage of the zygote.

**(iv) Tail :** It is very long, slender and tapering. It is formed of cytoplasm. It's main function is to provide mobility to the sperm. End piece consists of the exposed axial sheath, which forms a fine filament.



**Fig : Mammalian spam**

## **12.2 FEMALE REPRODUCTIVE SYSTEM :**

Female reproductive system comprises of following parts :

- (i) Ovaries    (ii) Fallopian tube    (B) Uterus

(iv) Vagina (v) Glands

**(i) Ovaries :** These are oval shaped lying near the kidney.

- Ovary is covered by two layers outer is made up of **germinal epithelial cells**.

- Inner layer is called as **tunica albuginea** which is made up of **fibrous connective tissues**.

- The ovary consists of inner part called as **stroma**.

- It's outer peripheral part is called as **cortex** while inner part is called a **medulla**.

- **Medulla** consists of connective tissues containing numerous blood vessels, lymphatic vessels and nerves.

- **Cortex** consists of graffian follicles in all the stages of development.

The developing oocyte is called as primary oocyte

This primary follicle undergoes maturation to form secondary follicle or secondary oocyte

It later on forms follicular layer

This follicular layer undergoes mitotic division to form secondary egg membrane.

This stage is called as secondary follicle

This is called as graffian follicle

### **FLOW CHART SHOWING THE FORMATION OF GRAFFIAN FOLLICLE**

- Cortex also consists of large mass of yellow cells termed as **corpus luteum**, formed in an empty graffian follicle after the release of it's ovum.

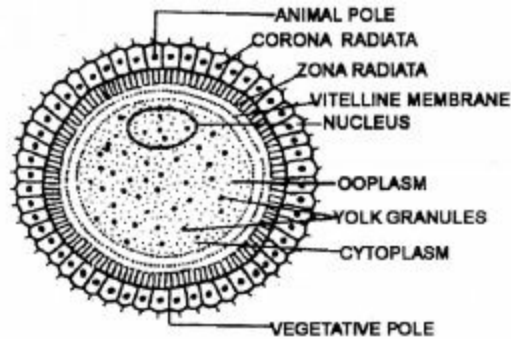
- The cells of corpus luteum secrete the hormones

**(A)** progesterone during pregnancy.

**(B)** Relaxing at the end of

pregnancy.

- Oestrogen is secreted by graffian follicle and intestinal cells. It's secretion is maximum during ovulation. It is also secreted during pregnancy.



**Fig : structure of ovum .**

**(ii) Fallopian tube :** It is about 10 cm. long muscular tube. It shows 4 regions :

**(A) Infundibulum :** It is the broad, funnel shaped proximal part of fallopian tube. It's margin bears finger like processes called as **fimbriae**. This is meant to carry ovum by ciliary movement to the uterus.

**(B) Ampulla :** It is a long, wide part of the fallopian tube next to the Infundibulum.

**(C) Isthmus :** it is the narrow part that follows ampulla.

**(D) Uterine part :** It is also narrow and passes through the uterine wall.

**(iii) Uterus :** It is large, highly elastic sac specialized for the development of the embryo.

- It is situated in a **pelvic cavity**.

- It is attached to the fallopian tube from the sides and below it opens into vagina through **cervix**.

- This uterus undergoes cyclic changes during phases of menstrual cycle.

**(iv) Cervix :** Lower narrow cervix that projects into the vagina. The cervix communicates above with the body of the uterus and below with the vagina.

**(v) Vagina :** It is a large, median, elastic, muscular tube. This canal

opens externally into **labia minora** and **labia majora**. Its folds consist of stratified squamous epithelium which has mucous lining. It secretes a lubricant fluid. **Labia majora** is the innermost, thin, moist fold. **Labia minora** is outer large and hair covered. pH of vagina is 4.3. It is also called a “**Birth canal**”.

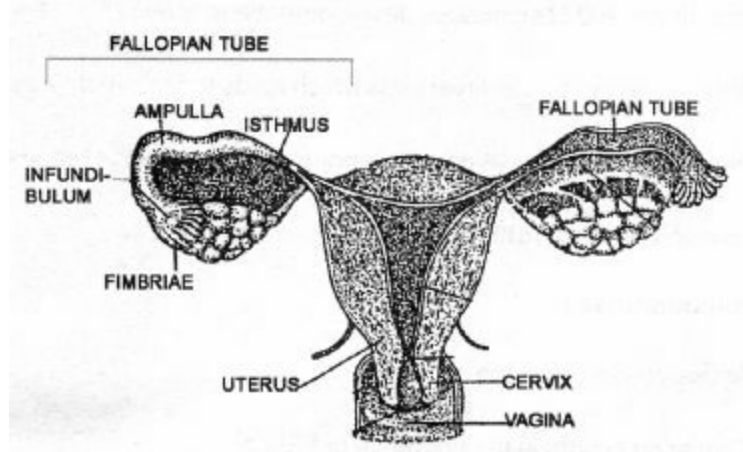
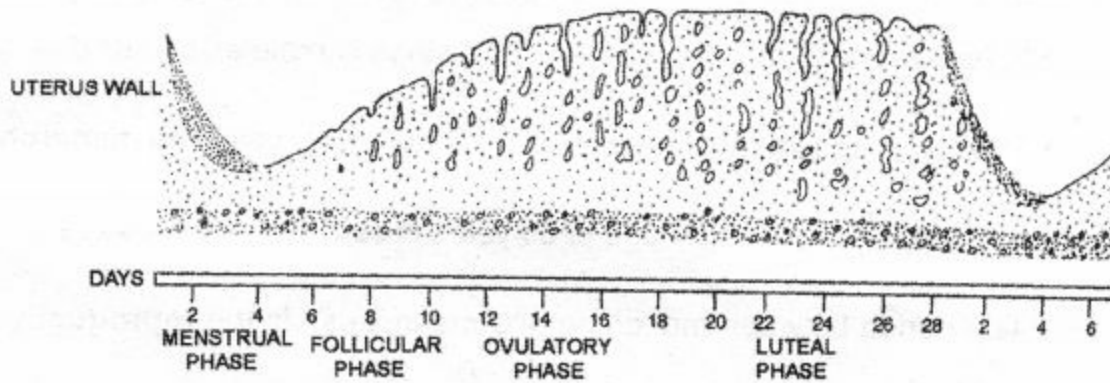


Fig : Female reproductive system.

#### (vi) Gland :

- **Bartholin's gland** : it secretes a clear, viscous fluid under sexual excitement.
- The fluid serves as a lubricant during copulation or mating.

#### 12.2 (a) Menstrual Cycle :



**FIG : SHOWING VARIOUS PHASES OF MENSTRUAL CYCLE**

- It is a cyclic phase of the flow of blood with mucus and tissues etc. from the uterus of a woman at monthly interval.
- It occurs on average of 28 days interval.
- It starts at the age of 12-14 years and stops at 45-50 years of life.
- This cycle stops during pregnancy.
- The menstrual cycle consists of following phases :

**(i) Bleeding or menstrual phase :**

- It is the first stage of menstrual cycle.
- It's duration is of 5 days but normally bleeding is found for 2-3 days.
- In this stage hormones **estrogen, progesterone, follicle stimulating hormone** and **luteinizing hormone** are found in minimum quantity.
- Total 100 ml, of blood flows in a complete bleeding phase.

**(ii) Proliferative phase :**

- In this phase F.S.H. stimulate development and maturation of graffian follicles.
- In this phase oestrogen level rises which leads to formation of new endometrium.
- It lasts for about 10 - 14 days. Thinnest endometrium is found in

this phase.

- It is also called as **follicular phase**.

### **(iii) Ovulation phase :**

- At this phase ovulation occurs.
- Ovulation occurs in the presence of FSH and LH.
- Thicket endometrium found in this stage.
- It also lasts for about 14 days.

**(iv) Secretory phase :** In this stage both oestrogen and progesterone levels are high.

- If fertilization takes place, this stage extends till to the parturition (giving birth to a child)

- If, fertilization does not take place, this stage completes on 28<sup>th</sup> day of menstrual cycle.

- The commencement of menstruation of puberty is called as **menarche**.

- It's stoppage around the age of 50 years is called as **menopause**.

- The period between menarche and menopause is the **reproductive phase** in human female.

## **12.2 (b) Oogenesis :**

Oogenesis is a process of formation of ovum. the ovum is a rounded, non-motile cell. It's size varies in different animals depending upon the amount of yolk in it.

**Ovum consists of two types of coverings :**

(i) Inner thin, transparent, non-cellular, covering called as **zona pellucida**. it is composed of protein and sugars. It is secreted y by

follicle cells.

(ii) Outer thick covering is called as **corona radiata**.

**Germinal epithelial cells**

**Primary Oocyte**

**division**

(i) **Secondary Oocyte** [23 chr.]      (ii) **Polar body**

**Futher division**

occurs      **Polar body**      **Polar body**  
Mature      **Polar body**  
oocyte  
or  
ovum

**FIG : THE PROCESS OF OOGENESIS**

### **12.3 FERTILIZATION :**

- It included release of ovum from the ovary, where it remains viable for 12 - 24 hours.
- At the time of sexual intercourse the sperm enters in to the vagina.
- Only one sperm is required for fertilization of the ovum.
- The head of the sperm penetrates the corona radiate layer of ovum and then the **zona pellucida** layer.
- This process if facilitated by acrosome and proteolytic enzymes.
- After penetration the tail and body of the sperm is lost, only head remains inside the ovum.
- It's head begins to swell and forms **male pronucleus**.
  - Here the pronuclei of sperm and ovum fuse to from a new

resultant nucleus each contributing 23 chromosome, so that the resultant may have 46 chromosomes.

### Sperm

With the help of acrosomes & proteolytic enzymes enter the ovum

Tail & body of the sperm is lost after it's entry in the ovum

Head of sperm swells up to form male pronucleus

This male pronucleus fuses with female pronucleus

Forms a new resultant nucleus with 46 chr. Each contributing about 23 of chromosomes.

### Zygote

### Embryo

### **Fig : Showing process of fertilization**

- Fusion of male & female gametes is called as **fertilization**. Zygote starts developing in fallopian tube and forms embryo, this later on moves to uterus. It gets attached to uterine walls and the whole process is called as **implantation**
  - Placental formation occurs between uterine wall and the foetus, which provides nourishment to the foetus.
  - The time period for which a developing fetus remains inside the mother's womb is called as **gestation period**. it extends for about 9 months or 40 weeks or 280 days.
- The process of giving birth to baby is called as **parturition**.



## 12.4 ARTIFICIAL INSEMINATION :

- It is a technique to make a female pregnant by artificially introduction semen into vagina.
  - In this process semen from a good quality male is collected, preserved by freezing and used when required.
- In case of humans it is also being used for improving the chances of fertility.
  - A man may be infertile due to insufficient number of sperms, weak or premature ejaculation, inability of penis to undergo and enter the vagina or nonmotile sperms.
    - In this case husband's semen is collected, concentrated and introduced artificially into the wife's vagina. this is called as **artificial insemination**.
    - If the husband's sperms are faulty, some donors sperm can be used. This is called as **artificial insemination donor**.
- **Artificial insemination has following two advantages.**
  - (i) Semen of good quality male animal is used to inseminate a number of females.
  - (ii) Preserved semen can be transported to distant places, excluding the need for sending the male animal there.

<b>Differences between asexual and sexual reproduction</b>	
Asexual reproduction	Sexual reproduction
1. It is always uniparental	It is generally biparental.
2. Gametes are not formed.	Gamete are formed
3. There is no fertilization.	Fertilization occurs in it.
4. In involves mitotic cell division.	It involves meiotic cell division.
5. Daughter individual are genetically identical to the parent	Daughter individual are different from theparents.
6. It does not contribut to the evolution.	It contributes to the evolution by introduction variation in the offspring

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## 12.5 POPULATION GROWTH:

- The term population refers to the total number of individuals of a species occupying particular geographical area at a given time.
- The scientific study of human population is called as “demography”.
- **Factors that lead to increase in population are :**
  - (i) Increase in protection from risk
  - (ii) Illiteracy
  - (iii) Desire of son
  - (iv) Decline in death rate
  - (v) Desire for more earning hands
  - (vi) Unawareness of various birth control measures

## 12.6 METHODS ADOPTED FOR POPULATION CONTROL

- (i) **Planned control of population :**
  - (A) By educating people about the advantages of small family.
  - (B) Raising the age of marriage can help in reducing population growth.
  - (C) By family planning.
- (ii) **Temporary methods :**
  - (A) **Safe period :** A week before and after the menstrual cycle is considered to be infertile and fertilization, does not occur during this period.
  - (B) **Coitus interrupts :** It involves withdrawal by males before ejaculation so that semen is not deposited, in vagina.
  - (C) **Chemical means :** These includes certain jellies, paste, foam tables which when introduced into vagina cause immobilization of sperms and

kill them. They also include contraceptive pills which inhibit secretion of F.S.H. and L.H. ovulation is inhibited.

**(D) Mechanical means :**

- They involve use of condoms.
- Use of cervical or diaphragm cap which is fitted in the vagina that checks the entry of sperms.

- **IUD (intrauterine device)** called as **copper-T** is also fitted in the uterus which prevents fertilization.

**(E) Surgical methods:** It involves **tubectomy** in females which involves cutting of fallopian tube, and **vasectomy** in males which involves cutting of vas deference from both the sides. However, surgical removal of ovaries also occurs which is called as **ovariectomy** and in males removal of testis called as **castration**.

- **Abortion** : Medical termination of pregnancy is called as **abortion**.

## DAILY PRACTICE PROBLEMS # 12

### OBJECTIVE QUESTIONS

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1. In mammals, the testes lies in scrotal sacs due to  
(A) presence of urinary bladder                      (B) presence of rectum  
(C) long vas-deference                      (D) requirement of low temperate for spermatogenesis
2. Graffian follicles are found in  
(A) testis of mammas    (B) ovary of frog    (C) ovary of cockroach    (D) ovary of mammals
3. Site of fertilization in mammals is

(A) ovary (B) uterus (C) vagina (D)  
fallopian tube

4. The process of reproduction which involves only a single parent to form an individual

- (A) sexual reproduction (B) asexual reproduction  
(C) none of these (D) Both A & B are correct

5. Cowper's glands are found in

(A) male mammals (B) female mammals (C) male amphibians  
(D) female amphibians

6. Loss of reproductive capacity in women after age of 45 years is

(A) menstruation (B) ageing (C) menopause (D)  
menarche

7. Release of oocytes from ovary is

(A) gestation (B) ovulation (C) parturition (D)  
implantation

8. Acrosome is made up of

(A) mitochondria (B) centrioles (C) golgi  
bodies (D) ribosomes

9. Acrosome aids the sperm to

- (A) penetrate vitelline membrane of ovum (B) find ovum  
(C) swim (D) higher activity

10. Progesterone is secreted by

(A) corpus luteum (B) thyroid (C) thymus (D)  
testis

## **SUBJECTIVE QUESTIONS**

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### **SHORT ANSWER TYPE QUESTIONS**

1. Why regeneration is considered to be a method of reproduction ?
2. When an organism is called as bisexual, what does it indicate ?
3. Define fertilization.
4. What happens to the ovule and the ovary after fertilization?
5. Define the term puberty.

### **LONG ANSWER TYPE QUESTIONS**

6. What is name the sexual cycle in human females called ? Explain the sexual cycle in human female.
7. What do you understand by gestation period and what is it's time duration ?
8. In case of self-pollination there are two possibilities. State them.
9. What is the function of fallopian tube ?
10. What is semen ?

## **ANSWER**

### **DAILY PRACTICE PROBLEMS # 11**

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<b>Que.</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>	<b>9</b>	<b>10</b>
<b>Ans.</b>	<b>C</b>	<b>D</b>	<b>C</b>	<b>A</b>	<b>B</b>	<b>B</b>	<b>B</b>	<b>B</b>	<b>A</b>	<b>C</b>

**DAILY PRACTICE PROBLEMS # 12**

<b>Que.</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>	<b>9</b>	<b>10</b>
<b>Ans.</b>	<b>D</b>	<b>D</b>	<b>D</b>	<b>B</b>	<b>A</b>	<b>C</b>	<b>B</b>	<b>C</b>	<b>A</b>	<b>A</b>

# HEREDITY & INHERITANCE

## BL-13

### 13.1 HEREDITY :

In includes those traits or characters which are transmitted from generation to generation and are therefore fixed for a particular individual.

- **Genetics** : Study of Heredity and variation is said to be known as **genetics**. The term genetics was first of all used by **W. Bateson** in 1905. An Austrian monk namely **Gregor Johann Mendel** was the first person to study genetics. He was therefore regarded at the '**Father of Genetics**'.

### 13.2 VARIATIONS :

Variation is concerned with the difference between the individuals of same species and also between the offspring of the same parents.

- **Variations could be of two types :**

**(i) Somatic variation**                      **(ii) Germinal variation**

**(i) Somatic variation** : Somatic variation affects the somatic cells of an organism. It is neither inherited from parents nor transmitted to next generation. It is acquired by individual during it's own life and is lost with it's death. It is therefore also called a **acquired variation** or

## **blastogenic variation.**

- **Somatic variations are due to :**

(A) **Environment** : This includes the factors that affect the organisms such as food, air, pressure, humidity, after etc. Environment affects all the organisms however they also affect the plants because they cannot move or hide themselves.

- **Light** : Strong sunlight affects the human skin by increasing the dark pigment melanin in the epidermal cells. Melanin protects the underlying cells by absorbing the ultra violet rays of the sun. Plants grown in shade become weak and pale and acquire long internodes and broad leaves.

- **Habitat** : It also affects the genetic make - up of an individual and leads to variations.

- **Nutrition** : It is also one of the various factors that cause variations.

(B) **Use of disuse of organs** : Continuous use of an organ makes it better developed whereas constant disuse makes it reduced.

(C) **Conscious efforts** : Conscious efforts by man produce somatic variations in humans themselves, in domestic animals and plants.

(ii) **Germinal variation** : This variation affects the germ cells of an organism and is consequently inheritable. It is received by the individual from the parents and is transmitted to the next generation.



- **Germinal variation could be of two types :**

(A) **Continuous variations** : [Fluctuating variations] The continuous variations are very common in nature. These are found in all animals and plants and affect all of their organs. These variations are unstable and do not contribute to the formation of new species.

- **Causes of continuous variations :**

- New combination of character
- Crossing over [recombination of genes]

(B) **Discontinuous variations** : This variation refers to large conspicuous differences of the offspring from the parents. This variation is also known as **mutation** and the individual with this kind of variation is called as **mutant**. This is not common in nature. It appears suddenly. It is stable and inheritable.

- **Causes of discontinuous variations :**

- Modification in structure of chromosomes.
- Alteration in the chemical nature of genes.
- Change in the number of chromosomes.
- Radiations and chemicals may also cause mutation.

- **Significance of Variation :**

- Variation enables the organisms to adapt themselves to the changing environment.

- It forms raw material for evolution.
- It enables the organisms to face the struggle for existence in a better way.

- It helps men in improving the races of useful animals and plants.
- It is the basis of heredity.
- It also leads to the existence of new traits.

### **13.3 HEREDITY AND VARIATION IN ASEQUAL REPRODUCTION :**

There are organisms in which reproduction occurs by asexual means.

These include Bacteria, Amoeba, Euglenas, fungi etc. many plants such as rose and sugarcane, lower animals namely Hydra, planaria etc.

This asexual reproduction is monoparental and the organism produced by it inherits all the traits of its single parent. It is almost a carbon copy of the parent and is known as its **clone**. It is also called as **clonal reproduction**. Here, one thing to be noted is the term '**offspring**' is not used in case of asexual reproduction.

- **The clones may develop variations :**
- By environmental factors
- By mutation

The variations caused due to environmental factors are not transferable but these variations which are caused by mutation are stable and inheritable.

### **13.4 HEREDITY AND VARIATIONS IN SEXUAL REPRODUCTION :**

Variation is very much common in animals and plants which carry reproduction by sexual means. The reason for this is the sexual reproduction is biparental and the offspring receives some traits from one parent and some traits from other parent. Interbreeding of closely related individuals reduces the occurrence of variations in the offspring's produced by the sexual reproduction.

### 13.4 (A) Earlier Views of Heredity :

Different theories have been put forward to explain in what physical form the traits pass from the parents to the offspring's.

(i) **Vapour theory:** This theory was proposed by a **Greek Philosopher Pythagoras**. he states that each organ of an animal body emitted some kind of water vapour and that a new individual was formed by the combination of these vapours from different organs.

(ii) **Fluid theory :** Another **Greek Philosopher Aristotle** [384 - 322 B.C.] stated that

(A) Man's semen is highly purified blood.

(B) Woman's menstrual fluid is the female semen, which was not as pure as man's semen.

(C) The two combines during intercourse and female semen provides substance for embryo formation and male semen provides from and vitality to embryo. This is called as **Blending theory of inheritance**.

(iii) **Preformation theory :** This theory was proposed by **Anton Von Leeuwenhoek** who was the first to observe human sperm. He called them "**animalcules**". He states that each sperm has a potential to develop into a new individual when introduced into the woman's womb where it could get nourishment. This theory was rejected because it failed to explain the inheritance of maternal characters by offsprings.

(iv) **Particulate theory :** A **French biologist Maupertius** proposed that each animal produces minutes particles for reproduction and a new individual is formed by the union of the particles of the two parents. Then a famous **English Naturalist Charles Darwin** forwarded the theory of **pangenesis** for the inheritance of characters. He assumed that tiny particles called **pangenes** or **gemmules** by his were formed in the various parts of the body and migrate to the reproductive cells and hence to the offsprings to guide the formation of the respective parts. Thus the young one has a blend (mixture) of the pangenes hence here is a

presence of the characters of both the parents.

Mendel was the first to give the **particulate theory of heredity**. He had experimented on pea plants to study how traits are transferred or inherited. He unfortunately failed to explain the cause of inheritance. He also proposed various principles to explain the inheritance. Later on other scientists led to the discovery of genes and chromosomes.

### **13.5 MENDEL'S EXPERIMENTS AND LAWS OF INHERITANCE :**

**Gregor Johann Mendel** is appropriately called as **Father of genetics**. With the help of his experiments on garden pea, he was able to formulate laws which explain the manner of inheritance of characters. Although Mendel described his **results in 1866**, his work was recognized only in 1900, when Mendel's laws were rediscovered simultaneously by **Hugo de Vries a Dutch biologist, Carl Correns a German botanist and Erich von Tschermak as Austrian botanist**.

- **Some general terms used by him are :**
  - **Dominant trait :** The trait which appears in F<sub>1</sub> generation is called as dominant trait. It is denoted by capital letter. **e.g. TT (tall)**.
  - **Recessive trait :** The traits which does not appear in F<sub>1</sub> generation is called as recessive trait. It is denoted by small letter, **e.g. tt (dwarf)**
  - **Monohybrid cross :** It involves the study of inheritance of one pair of contrasting character. **e.g.** Inheritance of tall and dwarf characters.
  - **Dihybrid Cross :** It is the inheritance of two pairs of contrasting characters.
  - **Trihybrid cross :** it is the inheritance of three pairs of contrasting characters.

- **Back cross** : The cross between F<sub>1</sub> generation with any of the parents is known as **back cross**.
- **Test cross** : The cross between F<sub>1</sub> generation and the recessive parent is called as **test cross**.
- **Genotype** : It is the genetic representation of a trait. **e.g. TT or Tt for a tall plant.**
  - **Reciprocal cross** : The reciprocal cross involves two crosses concerning the same characteristic but with reverse sex. It means if in the first cross A is female and B is male then in the second cross A will be male and B will be female.
  - **Phenotype** : it is the expression of a trait **e.g. Tall pea plant**, it can be noted by direct observation of an individual.
- **Allele** : Term allele refers to each of the members of a genetic pair.
  - **Homozygous traits** : They have similar alleles for specific trait (TT or tt). They produce only one type of gametes.
  - **Heterozygous traits** : They have dissimilar alleles for a specific trait (Tt). They produce two types of gametes

## 13.6 MENDEL'S EXPERIMENT

Mendel chose garden pea as plant material for his experiments, since it has following advantages.

- Well defined characters
- Bisexual flowers
- Predominantly self-fertilization
- Easy hybridization
- Cross fertilization is possible

### 13.6 (a) Crossing Technique Employed by Mendel :

Since garden pea is self-fertilizing, the anthers have to be removed before maturity. This operation is called as **emasculation**. The stigma is protected against any foreign pollen with the help of a bag. The pollens then at the dehiscence stage, is brought from the plant to be used as male parent and is dusted on the feathery stigma of the emasculated flower. At the time of pollination, the pollens should be **mature** and the

stigma should be **receptive**.

|Emasculation

|Bagging [for protection]

|Dehiscence [by dusting pollens]

Pollination

**(i) Traits chosen by Mendel for his experiment :** There are seven traits which Mendel has chosen, they are as follows :

S.No.	Characters	Dominant	Recessive
1.	Stem height	Tall	Dwarf
2.	Flower colour	Violet	White
3.	Flower position	Axial	Terminal
4.	Pod shape	Inflated	Constricted
5.	Pod colour	Green	Yellow
6.	Seed shape	Round	Wrinkled
7.	Seed colour	Yellow	Green

**(ii) Mendel performed experiments in three stages :**

(A) he made sure that, the plant which he had chosen must be true breeding plant, by letting the plant to undergo self-fertilization.

(B) He performed the process of cross pollination of alternate forms of traits. The resultant generation obtained was termed as hybrid, and these hybrids formed are called as **F<sub>1</sub> generation i.e.**

**First filial generation.**

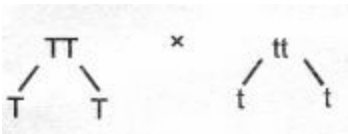
(C) He allowed the hybrid to self pollinate upto five generations and these generations are subsequently termed as F<sub>2</sub>, F<sub>3</sub>, F<sub>4</sub> and so on.

**(iii) Result's of Mendel's Experiments :**

(A) When the self pollination was made and F<sub>1</sub> generation was obtained, it was found that the resultant generation would express only one of the trait and not the other. The trait which is being expressed is called as **dominant**, whereas the one which is not expressed is called as **recessive** trait.

(B) In the F<sub>1</sub> generation obtained by self pollination, the dominant and the recessive traits obtained were in the ratio of **3 : 1** i.e. 75% of the offsprings which appeared in F<sub>2</sub> generation had dominant trait, while 25% had recessive trait. This ratio of 3 : 1 is also said to be known as **Mendelian monohybrid**

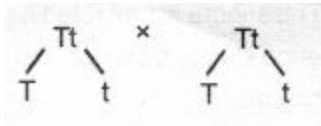
ratio .



	T	T

t	Tt	Tt
t	Tt	tt

**In F<sub>1</sub> all are tall**  
**(F<sub>1</sub> ≠ F<sub>1</sub>)**



	T	t
T	TT	Tt
t	Tt	Tt

**In F<sub>2</sub> we will get 3 : 1 ratio.**

TT □ Homozygous tall □  
 Tt □ Heterozygous tall □ Tall [3]  
 Tt □ Heterozygous tall □  
 tt □ Homozygous dwarf □ dwarf [1]

**Homozygous tall : Heterozygous tall : Homozygous dwarf**  
**1 : 2 : 1**



(C) Mendel further found that the phenotypic ratio of 3 : 1 of dominant to recessive form of a trait was actually a genotypic ratio of **1 : 2 : 1 of pure dominant, hybrid and pure recessive forms**. The traits which remain hidden in F<sub>1</sub> generation got expressed in F<sub>2</sub> generation. This was later on proved in F<sub>3</sub> generation.

**(iii) Reasons from Mendel's success :**

(A) He selected true breeding [pure] pea plant for his experiment.

(B) He studies single trait at a time.

(C) He kept an accurate mathematical record of his breeding experiments and noted down the number of each type of offspring produced in each cross.

(D) He was lucky enough to select the seen traits, as the gene for these traits are located on four different chromosomes.

### **13.7 MENDEL'S LAWS OF INHERITANCE :**

On the basis of the experiments performed and the result obtained Mendel formulated four laws. They are :

#### **13.7 (a) The Principle of Paired Factors :**

Each character in an individual is governed by two factors called as **gene**. The alternative form of gene is called as **alleles** or **allelomorphs**. If an individual consists of similar types of **alleles**, they are called as **homozygous e.g.** TT, tt while those having different types of alleles are called as **heterozygous e.g. Tt** etc.

#### **13.7 (b) The Principle of Dominance or Law of Dominance :**

When two homozygous individuals with one or more sets of contrasting character are crossed the characters that appear in the F<sub>1</sub> hybrids are dominant characters and those which do not appear in F<sub>1</sub> are recessive characters.

#### **13.7 (c) The Principle of Segregation or Law of Segregation :**

[Law of purity of gametes] The law of segregation states that when a

pair of contrasting factors or genes or alleles are brought together in a heterozygous condition, the two remains together without being contaminated but when gametes are formed from them the two separate out from each other. This is also known as **Mendel's first law of heredity**.

### **13.7 (d) The Principle of Independent Assortment or Law of Independent Assortment:**

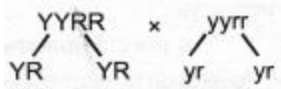
If the inheritance of more than one pair of characters is studied simultaneously, the factors or genes for each pair of characters assort out independently. It is called as **Mendel's second law of heredity**.

### **13.8 DIHYBRID CROSS :**

In dihybrid cross Mendel crossed genetically pure yellow round seeded (YYRR) pea plant with green wrinkled (yyrr) pea plant. All the plants of F<sub>1</sub> were all yellow and round seeded (YyRr). In F<sub>2</sub> generation four types of plants appeared as :

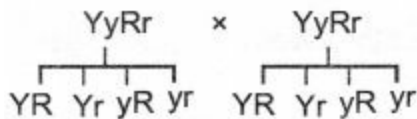
- Yellow rounded - 9
- Yellow wrinkled - 3
- Green round-3
- Green wrinkled - 1

So here phenotypic ratio is 9 : 3 : 3 : 1



	<b>yr</b>	<b>yr</b>
<b>YR</b>	<b>YyRr</b>	<b>YyRr</b>
<b>YR</b>	<b>YyRr</b>	<b>YyRr</b>

All F<sub>1</sub> plants are yellow and round seeded



	<b>YR</b>	<b>Yr</b>	<b>yR</b>	<b>yr</b>
<b>YR</b>	<b>YYRR</b>	<b>Yyrr</b>	<b>YyRR</b>	<b>YyRr</b>
<b>Yr</b>	<b>YYRr</b>	<b>Yyrr</b>	<b>YyRr</b>	<b>Yyrr</b>
<b>yR</b>	<b>YyRR</b>	<b>YyRr</b>	<b>yyRR</b>	<b>yyRr</b>
<b>yr</b>	<b>YyRr</b>	<b>Yyrr</b>	<b>yyRr</b>	<b>yyrr</b>

### 13.9 GENES :

The term ‘**gene**’ was introduced by **Johansson** for Mendelian factor. Gene determines the physical as well as physiological characteristics. They are transmitted from parents to their offsprings generation after generation. Genes are located on chromosomes where they occupy specific position called as **locus**. **This** was proved experimentally by **T.Bovery** and **W.S. Sutton** in 1902. They are responsible for characteristic features.

### **13.9 (a) Molecular Structure of Gene :**

Chemically gene is formed of DNA. It consists of following parts :

**(i) Recon :** It is the smallest unit of DNA capable of undergoing crossing over and recombination.

**(ii) Muton :** It is also the smallest unit of DNA capable of undergoing mutation.

**(iii) Cistron :** It is a gene in real sense, which consists of number of **nucleotides** and which is capable of synthesizing a polypeptide chain of enzymes.

**(iv) Replicon :** It is a unit of replication.

## DAILY PRACTICE PROBLEMS # 13

### OBJECTIVE QUESTIONS

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1. When a red flower homozygous pea plant is crossed with a white flower plant what colour is produced in  $F_1$  ?  
(A) Red (B) White (C) Pink (D) Red and white
2. Mendel formulated the law of purity of gametes on the basis of  
(A) dihybrid cross (B) monohybrid cross (C) back cross (D) test cross
3. A cross between  $AaBB \times aaBB$  yields a genotypic ratio of  
(A) 1  $AaBB$  : 1  $aaBB$  (B) 1  $AaBB$  : 3  $aaBB$  (C) 3  $AaBB$  : 1  $aaBB$  (D) All  $AaBb$
4. In monohybrid cross what is the ratio of homozygous dominant and homozygous recessive individual in  $F_2$  - generation ?  
(A) 1 : 2 : 1 (B) 2 : 1 / 1 : 2 (C) 3 : 1 / 1 : 3 (D) 1 : 1
5. Back cross is a cross between  
(A)  $F_1 \times F_1$  (B)  $F_1 \times$  Recessive (C)  $F_1 \times$  Dominant (D)  $F_1 \times$  any parent
6. A white flowered mirabilis plant  $rr$  was crossed with a red coloured  $RR$ , if 120 plants are produced in  $F_2$  generation. The result would be  
(A) 90 uniformly coloured and 30 white (B) 90 Non - uniformly coloured and 30 white  
(C) 60 Non-uniformly coloured and 60 white (D) All coloured and No white
7. Which one carries extra nuclear genetic material ?  
(A) Plastids (B) Ribosomes (C) Chromosomes (D) Golgi - complex
8. The ratio of phenotype in  $F_2$  generation of a dihybrid cross is

(A) 3 : 1                      (B) 1 : 2 : 1                      (C) 2 : 1                      (D) 9 : 3 :  
3 : 1

9. Branch of biology deal s with heredity and variation is called  
(A) Palaentology      (B) Evolution      (C) Genetics      (D)

Ecology

10. The factors which represent the contrasting pairs of characters are called

(A) Dominant      (B) Recessive      (C) Determinants      (D)  
Alleles

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## **SUBJECTIVE QUESTIONS**

### **SHORT ANSWERT YPE QUESTIONS**

1. What are autosomes ?
2. Name the four nitrogen bases of a nucleotide.
3. Define the term genetics.

### **LONG ANSWER TYPE QUESTIONS**

4. What does the science of genetics deals with ?
5. Differentiate between submetacentric and metacentric chromosomes with diagram.
6. Explain the structure of a gene.
7. What is genetic engineering ?
8. Why did Mendel choose pea (*Pisum sativum*) for his experiment ?

# HEREDITY & INHERITANCE

## BL-14

### 14.1 CHROMOSOMES :

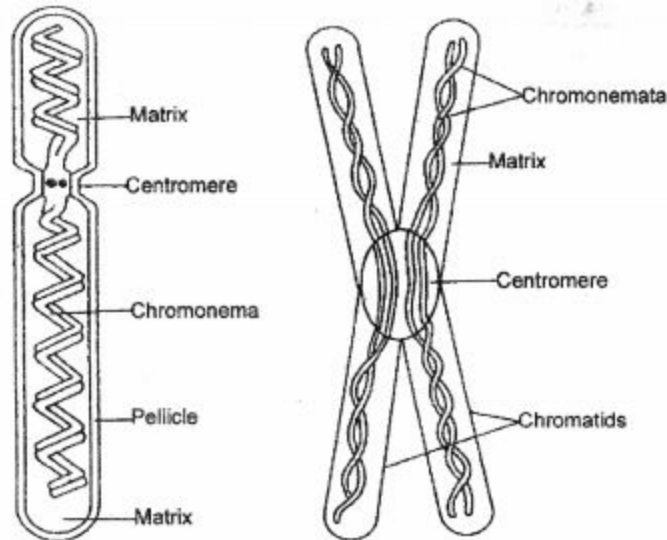
**E.Strasburger** discovered chromosomes in 1875. They are thread like structure and are called as chromosomes due to their affinity towards **dyes [chroma = colour]**. **Genes** are located on chromosomes and the genetic material of chromosomes is DNA. These are also called as “**hereditary vehicles** “ as they are capable to transmit hereditary material to the next generation.

• **Chromosomal theory of Inheritance: Sutton and Boveri**  
Proposed this theory in 1902. This theory consists of following salient features :

- Somatic cells are diploid in number i.e. these consist of two sets of chromosomes, one set from the mother and other set from the father.
- The chromosomes retain their structural uniqueness, identity and continuity.
- The paired condition of chromosomes is resorted during fertilization.
- The behavior of chromosomes during meiosis at the time of gamete formation provides an evidence that genes are located on chromosomes. This also explain the mechanism of segregation of characteristic at the time of gamete formation.

## 14.1 (a) Structure of chromosomes :

Each chromosome consists of two strands which are called as **chromatids**. The two chromatids of a chromosome are joined together at a point called as **centromere**.



### (a) Structure of chromosome (b) Metaphase chromosome.

- Depending on the position of centromere a chromosome can be of different types and attain different shapes during anaphase. They are :

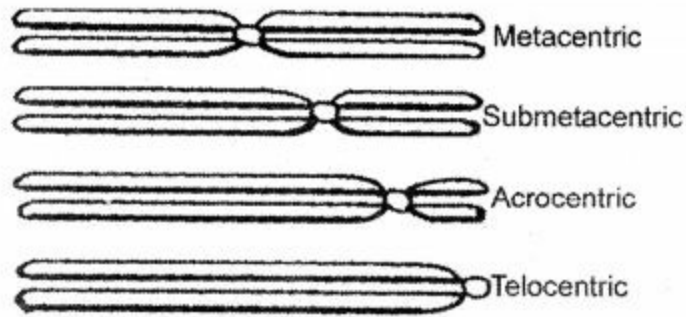
**(i) Metacentric** : They are V - shaped. These have centromere in the middle of chromosome so that the two arms are almost equal.

**(ii) Sub metacentric** : They are L shaped. In this centromere is slightly away from the mid point, so that the two arms are unequal.

**(iii) Acrocentric** : They are J-shaped with centromere at subterminal position.

**(iv) Telocentric** : They are rod shaped, having terminal centromere.





## Types of chromosomes.

### 14.1 (b) Size and Shape of Chromosomes :

Size of chromosomes greatly vary during cell cycle.

**(i) Interphase :** It forms long thread like structure called as **chromatin**.

**(ii) Metaphase :** Chromosomes are thickest and shortest and therefore have definite shape and size. At this stage chromosomes can be counted easily.

**(iii) Anaphase :** They have rod like J-shaped or V- shaped structures during this phase.

**(iv) Telophase :** They have thread like structure.

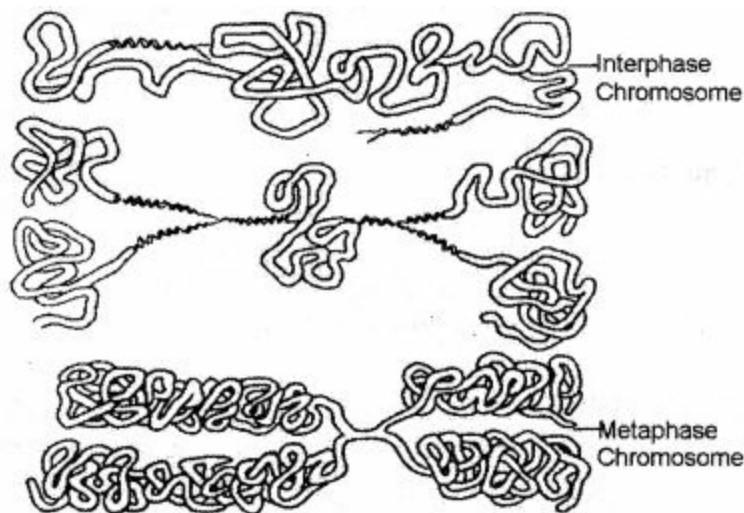


Fig : To show condensation of chromatin network.

### 14.1 (c) Number of Chromosomes :

Each species has a fixed number of chromosomes in its cells. In case of human beings, there are 46 number of chromosomes in each body cell. 46 chromosomes in an ordinary human cell are of 23 different types. So, there are two chromosomes, of each kind. The two chromosomes of each kind are called as homologous chromosomes. A cell which has the full number of chromosomes with two of each kind is called as diploid cell. In other words a diploid cell has two sets of each type chromosomes. The gametes (or sex cells) of human being are different from their other body cells because they contain only half the number of chromosomes.

A cell which has half the number of chromosomes, with one of each kind, is called as haploid cell. In other words a haploid cell has only one set of each type of chromosomes **e.g. sperm** and **eggs** have only 23 chromosomes each, which is half the number of chromosomes of other body cells. So, the gamete is a haploid cell. Females consists of two similar gametes and therefore called as homogametic and males consist of dissimilar gametes and therefore called as heterogametic. The term homomorphism and heteromorphy are also used for females and males respectively. During spermatogenesis two types of sperm cells will be produced one which contains X chromosome and the other which contains Y chromosome. During oogenesis each egg will produce two X chromosomes. If X-chromosome of male fuses with X-chromosome of female it will produce a female child. If Y-chromosome of male fuses with X-chromosome of female it will produce a male child.

### 14.1 (d) Properties of Chromosomes :

The chromosomes must poses five important properties :

- (i) **Replication** : Synthesis of new DNA molecule which is identical to the parent DNA molecule.
- (ii) **Transcription** : Synthesis of RNA molecule from DNA molecule.
- (iii) Change in appearance.
- (iv) **Repair** : It means repair of damaged parts of DNA.
- (v) **Mutation** : Development of genetic changes.

## 14.1 (e) Functions of Chromosomes :

- (i) They carry hereditary characters from parents to offsprings.
- (ii) They help the cell to grow, divide and maintain itself by synthesis of proteins.
- (iii) They undergo mutation and thus contributed to the evolution of animals.
- (iv) They guide cell differentiation during development.
- (v) They also help in metabolic processes.
- (vi) They bring about continuity of life.

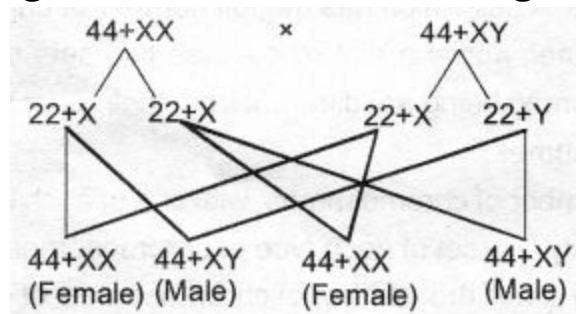
## 14.2 SEX DETERMINATION :

- **Chromosomes are of two types :**
- **Autosomes or Somatic chromosomes :** These regulate somatic characters.
  - **Allosomes or Heterosomes or Sex chromosomes :** These chromosomes are associated with sex determination. Sex chromosomes were first discovered by “**Mc Clung**” in grasshopper. X chromosome was discovered by **Henking**.

### 14.2 (a) X X - XY Type or Laygaues Type :

This type of sex determination is first observed by **Wilson** and Stevens in **Laygaeus insect**. It is of two types :

- (i) **X X female and XY male :** In this type of sex determination female is **homogametic** while males is **heterogametic e.g. Humans**



- (ii) **XY female and XX male :** In this type of sex determination

female is **heterogametic** while males is

**homogametic. e.g.** Butter flies, moth and vertebrates like birds, fishes and reptiles.

### **14.2 (b) XX Female and XO Male or Pronetor Type :**

sIn this type of sex determination there is a deficiency of one chromosome in male. In this type female is homogametic and male is heterogametic. **e.g. Grasshopper and Cockroach**

### **14.3 GENETIC ENGINEERING :**

In recent years, techniques for manipulation of prokaryotic as well as eukaryotic DNA have witnessed a remarkable development. This has allowed breakage of a DNA molecule at two desired places to isolate a specific DNA segment and than insert it in another DNA molecule at the desired position. The product thus obtained is called as **recombinant DNA** and the process is called as “**genetic engineering**”.

#### **14.3 (a) Tools of Genetic Engineering :**

The various biological tools used in the synthesis of recombinant DNA are :

(i) Enzymes                      (ii) Vehicle or vector DNA

**(i) Enzymes :**

**(A) Lysing enzyme :** These are used to open up the cells to get DNA for genetic experiment.

**Lysozyme** is commonly used to dissolve the bacterial cell wall.

**(B) Cleaving enzymes :** These are used to break DNA molecule. Three types of cleaving enzymes are known. They are :

- **Exonuclease :** Which cut off nucleotides from 5' or 3' ends of

DNA molecules.

- **Endonuclease** : Which cleaves the DNA duplex at any point except ends.

- **Restriction endonucleases** : Restriction endonucleases are the enzymes which recognize specific nucleotide sequence and cut the DNA molecules. Restriction endonuclease was discovered by **Arber** in **Escherichia coli**. **Nathans (USA), Smith, Arber** won the Noble prize for **Physiology and Medicine** in 1978 for the discovery of restriction endonuclease.

**(C) Synthesizing enzymes** : These play an important role in the synthesis of DNA strands on suitable templates. They are of two types :

- **Reverse transcriptase** : These help in the synthesis of complimentary DNA strands on RNA templates.

- **DNA polymerase** : This helps in the synthesis of complimentary DNA strands on DNA templates.

**(D) Joining enzymes** : These help in sealing gaps in DNA fragment which are joined by complimentary base pairing **e.g. T<sub>4</sub> - ligase**.

**(E) Alkaline phosphatase** : These cut off phosphate groups from free ends of linearized vehicle DNA to prevent recircularization.

**(ii) Vehicle or vector DNA** : The DNA used as carrier for transferring a fragment of foreign DNA into a suitable host called as vehicle DNA. **e.g. Plasmid and Bacteriophage DNA**.

### **14.3 (b) Application of Genetic Engineering :**

**(i)** It is applied for modification of plant colours.

**(ii)** It helps in cloning of transgenic plants.

(iii) It can be proved beneficial in case of plants e.g. “nif” gene is transferred in plants which is responsible for N<sub>2</sub> fixation.

(iv) It is used for curing various genetic disorders.

(v) It can be proved beneficial for synthesis of insulin growth hormone etc.

(vi) It can be used to delay ripening of fruits.

#### 14.4 DNA : (DEOXYRIBOSE NUCLEIC ACID)

DNA was first isolated by **Frederick Meischer** from the nucleus of **pus cells** and called as **nuclin**. **Watson and Crick** gave the double helix model of DNA. They also won a noble prize for it. Chromosomes consist of nucleoprotein which are made up of nuclei acid and proteins.

##### 14.4 (a) Composition of DNA :

DNA molecule consists of following three components :

(i) Deoxyribose sugar

(ii) Phosphate group

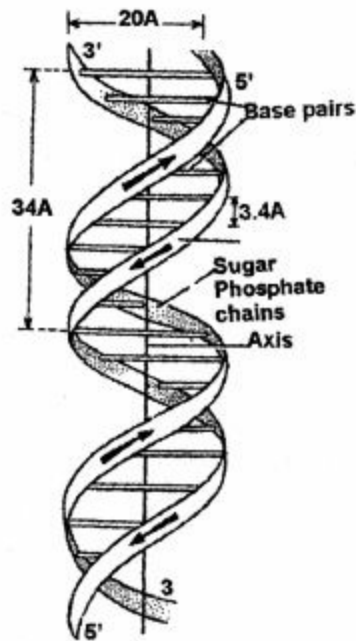
(iii) Nitrogen bases : They could be **purines or pyrimidines**.

(A) **Purines are** : Adenine [A] and Guanine [G]

(B) **Pyrimidines are** : Thymine [T] and Cytosine [C]

- One DNA molecule consists of a unit called **nucleotide**.
- Nucleotide = nucleoside + phosphate
- Nucleoside = nitrogen base + deoxyribose sugar

## 14.4 (b) Structure of DNA :



**Structure of a DNA molecule**

(i) It consists of two helical polypeptide chains which are coiled around each other.

(ii) Both the chains are antiparallel to each other.

(iii) Both chains have complementary base pairing i.e. A = T and G = C.

(iv) The two strands are held together, by hydrogen bonds.

(v) The diameter of a DNA molecule is 20 Å.

(vi) One helix consists of about 10 bp.

(vii) Its helical length is 34 Å and the distance between two nearest base pairs is 3.4 Å.

(viii) It also consists of major and minor grooves.

(ix) Each strand consists of a backbone made up of alternating deoxyribose sugar and phosphate, they are joined by **phosphodiester bonds**.

## 14.5 SOME IMPORTANT TERMS :

- **Karyotype** : It includes the details of the number of chromosomes of an organism, their size and shape. It is better achieved in metaphase stage.
- **Idiotypic** : It is a diagrammatic representation of a karyotype.
  - **Banding technique** : For the purpose of identification of chromosomes a special staining technique is used. It is called as **banding technique**.
  - In the process of genetic engineering the gene that is transferred into an organism is called as **transgene**. An organism that contains and expresses a transgene is called as **transgenic organism or genetically modified organism [GMO]**.



- Hirudin is a protein that prevents blood clotting. The gene encoding hirudin is chemically synthesized. This is then transferred to *Brassica napus*, where hirudin is accumulated in seeds. It is then purified and used as medicine.

- A soil bacterium ***Bacillus thuringensis***, produces a crystal “**cry**” protein. This protein is toxic to the larvae of certain insects. There are various types of cry protein each resistant to specific type of insect.

- Viral chromosomes consist of proteins and one nucleic acid i.e. DNA or RNA. Nucleic acid may be single or double stranded, may be circular or linear. Virus with RNA as genetic material is called as **retrovirus e.g. HIV** [Human Immuno Deficiency Virus]

- **Replication** : DNA is the only molecule capable of self duplication so it is termed as “living molecule”. All living beings have the capacity to reproduce because of this characteristic of DNA. DNA replicates in the “S” phase of cell cycle. In the process of replication a new DNA is synthesized in the form of strands.

- **These strands are of two types :**

- (i) **Leading strands** : Formation of new strands always takes place in 5’ - 3’ direction. It is a continuous strand.

- (ii) **Lagging strand** : it is formed as small fragments known as **okazaki fragments**. These fragments are later on joined by **ligase enzymes**.

## DAILY PRACTICE PROBLEMS # 14

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## OBJECTIVE QUESTIONS

1. The main aim of plant breeding is  
(A) to produce improved varieties (B) to make soil fertile  
(C) to control pollution (D) to become more progressive
2. Plants having similar genotypes produced by plant breeding are called  
(A) clone (B) haploid (C) autopolyploid (D) genome
3. Two allelic genes are located on  
(A) the same chromosome (B) two homologous chromosomes  
(C) two non-homologous chromosomes (D) any two chromosomes
4. Mendel's law of segregation is based on separation of alleles during  
(A) gamete formation (B) seed formation (C) pollination (D) embryonic development
5. What is the effect of sexual reproduction ?  
(A) Offspring is weak (B) Offspring is like the parent  
(C) Offspring is more vigorous (D) Offspring is diseased
6. Disease resistant varieties can be produced by  
(A) crossing a plant with wild variety (B) treating with colchicine  
(C) crossing with hormones (D) treating with low temperature
7. Heterozygous tall plants were crossed with dwarf plants, what will be the ratio of dwarf plants in the progeny  
(A) 50% (B) 25% (C) 75% (D) 100%
8. A pure tall plant can be differentiated from a hybrid tall plant  
(A) by measuring length of plant  
(B) by spraying gibberellins

- (C) if all plants are tall after self-pollination
- (D) if all plants are dwarf after self-pollination

9. Allel is the

- (A) alternate trait of a gene pair
- (B) total number of genes for a trait
- (C) total number of chromosomes of haploid set
- (D) total number of genes present a chromosome

10. In animals sex determination is due to

- (A) X-chromosome
- (B) Y - chromosome
- (C) A - chromosome
- (D) B - chromosome

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## SUBJECTIVE QUESTIONS

### SHORT ANSWER TYPE QUESTIONS

1. What is karyotype ?
2. What is meant by chromosomes ?
3. Who is known as the father of genetics ?
4. What determines the functional property of a gene ?
5. What was transgenic organisms ?

### LONG ANSWER TYPE QUESTIONS

6. What does the law of segregation states ?
7. What do you understand by the term nucleoside and nucleotide ?
8. How it was established that genes are located on chromosomes ?
9. Explain the importance of variations.
10. Explain the law of dominance.

# ANSWERS

## DAILY PRACTICE PROBLEMS # 13

<b>Que.</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>	<b>9</b>	<b>10</b>
<b>Ans.</b>	<b>A</b>	<b>B</b>	<b>A</b>	<b>D</b>	<b>D</b>	<b>B</b>	<b>A</b>	<b>D</b>	<b>C</b>	<b>D</b>

## DAILY PRACTICE PROBLEMS # 14

<b>Que.</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>	<b>9</b>	<b>10</b>
<b>Ans.</b>	<b>A</b>	<b>A</b>	<b>B</b>	<b>A</b>	<b>C</b>	<b>A</b>	<b>A</b>	<b>C</b>	<b>A</b>	<b>B</b>

# OUR ENVIRONMENT

## 15.1 ECOSYSTEM :

- The term Ecosystem was coined by **Tansley**. According to him Ecosystem is a symbol of structure and function of nature.
  - The term Ecology was coined by **Reiter**.
  - The term Ecology was first of all described by **E.Haeckel**.
  - Father of India Ecology - Prof. **Ramdas Mishra**.
- \*8 The boundaries of ecosystem are indistinct and have an overlapping character with each other.
- “The total group of living things and environment of factors present in a particular place is called as ecosystem/”
  - It means any structural and functional unit of the environment that can be identified and studied is called as ecosystem.
  - Ecosystem may be natural or artificial, permanent or temporary. Large ecosystem is called as **biome** such as desert, forest etc.
  - **Homeostasis** : Self maintainable characteristic is found in ecosystem. It means an ecosystem maintains the balance between the different trophic levels. Each trophic level controls the other trophic level in an ecosystem.
  - **Cybernetics** : A science of self control [homeostasis] in an

ecosystem is called as “cybernetics”

### **15.1 (a) Types of Ecosystem :**

Natural (e.g. lake, forest, grassland etc.) or man made (e.g. an aquarium crop field etc.)

**(i) Temporary** : e.g. rain-fed pond etc.

**(ii) Permanent** : e.g. lake, forest etc.

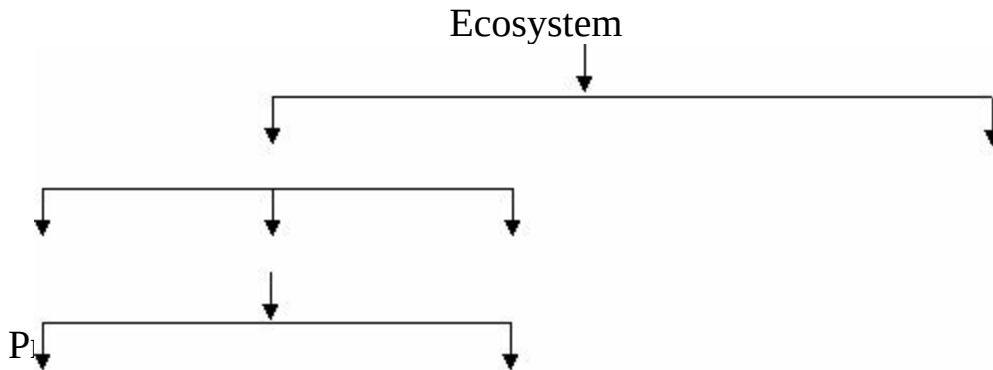
- An ecosystem may be as small as a drop of pond water. Such small ecosystem is called as micro ecosystem. Human activities may modify or convert natural ecosystem into man made ecosystem. Cutting tree or forests and the conversion of land for tree plantation or agriculture etc. are some of the examples of conversion of natural ecosystem to man made ecosystem.

### **15.1 (b) Components of Ecosystem :**

Ecosystem consists of two components :

**(i) Biotic component**                      **(ii) Abiotic component** (environment, soil etc.

**(i) Biotic components** : Different biotic components are connected, through food chain or other relations. That is why it is said that all the living organisms comes under biotic components. Food available for biotic components can be synthesized, from inorganic raw material by the autotrophs only.



Primary consumers      Secondary consumers      Top consumers

- Biotic components are of three types which are essential for ecosystem.

**(A) Producers :** All the autotrophs of ecosystem are called as producers. The green plants are the main producers. Green plants absorb solar energy and convert it into chemical energy. It means energy enters into the ecosystem through the producers. The solar energy is the only ultimate source of energy in ecosystem. This energy is available to the remaining living organisms through the medium of food.

**(B) Consumers:** All the heterotrophs of the ecosystem are known as consumers. Animals are the main consumers. They directly (herbivorous) or indirectly (carnivorous) depend upon the producers. There are various types of consumer which are as follows :

- **Primary consumers :** They are also known as secondary producers because they synthesize complex materials in the cells by the digestion of food which they obtain from the plants. Such living organisms which obtain food from the producers are known as primary consumers. Such as all the herbivores of ecosystem.

- **Secondary consumers** : Animals which feed upon primary consumers and obtain their food. It means those carnivorous which kill and eat the herbivorous. So that they are called as predators **e.g.** Dog, Cat, Snake etc. In aquatic system whale fish is a secondary consumer.
- **Top consumers** : Those animals which kill other animals and eat them by they are not eaten by other animals in the nature **.e.g** Lion, Vulture, Peacock and Man (human) in our ecosystem. Man and peacock may be omnivorous.

**(C) Decomposers or Microconsumer** : Those living organisms which decompose the dead bodies of producers and consumers and release mineral substances again into the soil which are present in the dead bodies. So that decomposers help in mineral into the soil which are present in the dead bodies. So that decomposers help in mineral cycle. Only because of this land is the main source of minerals. The main decomposers in ecosystem are - bacteria and fungi which decompose continuously dead animals and dead plants.

**(D) Scavengers** : Vulture never kills any animal so that vulture is a scavenger, not a decomposer. The process of decomposition takes place outside the body of bacteria. The break down of the food materials takes place in the body of vulture and minerals are released into the soil in the form faecal material. They are also called as reducers because they decomposes and remove the dead bodies of the organism.

### **15.1 (c) Structure of an Ecosystem :**

The structure of an ecosystem is characterized by the physical organization of biotic & abiotic components. The major structural features of an ecosystem are species composition, stratification, trophic organization and nutrients.

**(i) Species composition** : Each ecosystem has its own type of species composition. Different ecosystems have different species composition. A great variety of species is found in forest ecosystem,



whereas a few species occur in a desert ecosystem.

**(ii) Stratification** : The organisms in each ecosystem from one or more layers or strata, each comprising the population of particular kind of a species.

**(iii) Trophic organization** : Food relationship of producers and consumers is another way to predict ecosystem structure. In an ecosystem there can be only 4 - 5 successive trophic levels because

**(A)** All the food available in one trophic level is not being eaten by another animal in the next trophic level.

**(B)** All the food eaten by an animal is not useful, thus a part of energy containing food is passed out as waste products.

**(C)** A large amount of energy is lost in respiration to drive organisms metabolism and thus, there is not much energy left to support higher trophic levels.

### **Fig : Trophic levels in Ecosystem**

- The amount of nutrients such as nitrogen, phosphorus and calcium present in the soil at any given time is termed as standing state.

#### **15.1 (d) Functions of an Ecosystem :**

**(i) Productivity** : Ecosystem helps to maintain the productivity, of the system. The rate of organic matter or biomass production is called as productivity. The study of biomass production in the ecosystem is called as production ecology.

**(ii) Energy flow** : Energy flow in an ecosystem is a key function of an ecosystem. It determines the following two laws of Thermodynamics :

**(A) First law** : It states, that energy can neither be created nor

destroyed, but can be transferred from one from to other.

**(B) Second law :** It states, that every energy change involves the degradation or dissipation of energy,

from concentrated to the dispersed form due to metabolic functions, so that only a small part of energy is stored in the biomass.

**(iii) Nutrient cycles :** All living organisms get matter from the biosphere component i.e. lithosphere, hydrosphere and atmosphere. Essential elements or inorganic substances are provided by earth and are required by organisms for their body building and metabolism, they are known as biogeochemical or biogenetic nutrients.

**(iv) Development and stabilization :** This function is necessary for the development and giving stability to various life form's by undergoing certain modifications.

## 15.2 FOOD CHAIN :

- The chain of organisms which involves transfer of energy from one trophic level to next trophic level is called as food chain.

- The flow of food or energy in an ecosystem is called **Food chain**. Those organisms which join with the food chain are termed as **Trophic levels**.

- Usually, there are four trophic levels present in the ecosystem because level of energy decreases during the flow of energy from one trophic level to the another trophic level.

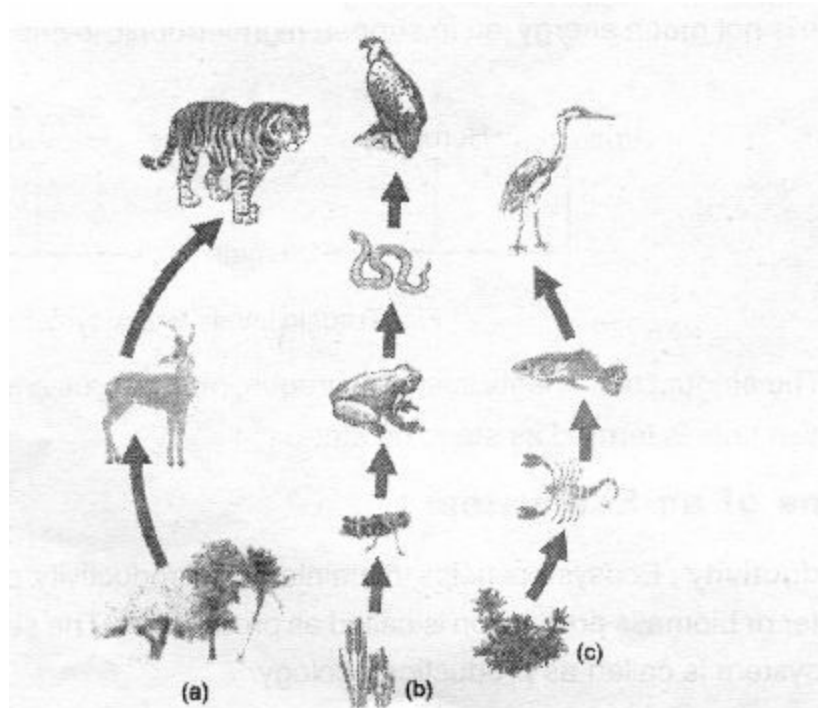
**First trophic level [T<sub>1</sub>]** : Producers

**Second trophic level [T<sub>2</sub>]** : Primary consumers

**Third trophic level [T<sub>3</sub>]** : Secondary consumers

**Fourth trophic level [T<sub>4</sub>]** : Top consumers

- The flow of energy occurs in an ecosystem from the first trophic level to the fourth trophic level in the food chain. These are five trophic levels also found in a highly complex ecosystem in which tertiary consumers are present in between the secondary consumer and top consumers, then fifth trophic level (T<sub>5</sub>) formed by the **top consumers**.



**Food chain in nature (a) in forest , (b) in grassland & (c) in a pond**

## 15.2 (a) Types of food Chain :

There are three types of food chains which are found in nature.

- (i) Predator food chain      (ii) Parasitic food chain      (iii) Saprophytic food chain

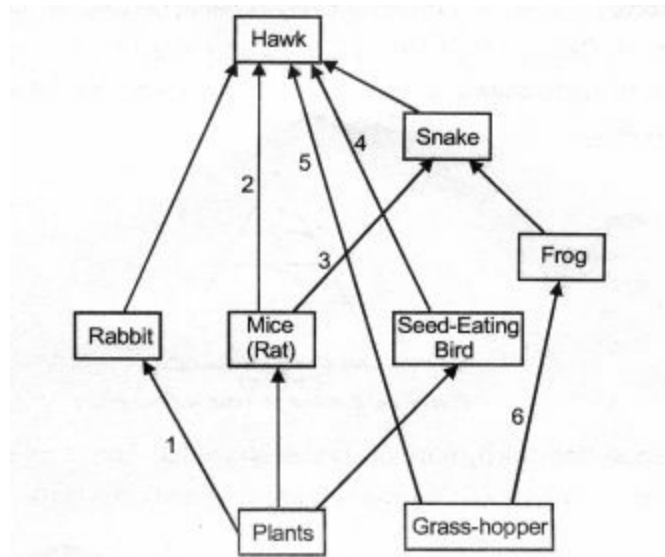
- Predator food chain extends from producers through herbivores to carnivores, parasitic food chain starts from producers but ends with parasites and saprophytic food chain starts with decomposers. Producers are autotrophic organisms which synthesize organic food from simple inorganic raw material through photosynthesis by utilizing solar energy. A part of food synthesized by the producers is used in their body building, while the rest is utilized in providing energy for various life activities.

- **Some common predator food chains are given below :**
- Vegetation □ Grasshopper □ Shrew □ Hawk
- Vegetation □ Rabbit □ Wolf □ Tiger
- Vegetation □ Frog □ Snake □ Peacock

- Plant → Rat → Snake → Hawk.
- **Aquatic food chains :**
- Phytoplanktons → Zooplanktons → Small crustacians  
→ Predator insect → Small fish → Large fish → Crocodile
- Phytoplanktons → Zooplanktons → Small fish → Large fish  
Shark
- Phytoplanktons → Zooplanktons → Fish → Crane → Hawk.

### 15.3 FOOD WEB :

In nature, the food chains are not isolated sequences but are rather interconnected with one another. “A network of food chains which are interconnected at various trophic levels, so as to form a number of feeding connections amongst different organisms of a biotic community is called as food web. The food web opens several alternate pathways for the flow of energy. Generally, food web operates according to test and food performances of the organisms at each trophic level, yet availability of food source and other compulsions are equally important. The concept of food web appears to be more real than that of simple food chain. The food web increases the stability of an ecosystem by providing alternate source of the food and allowing endangered population to grow in size. Many food chains are interlinked together to form food web in a big ecosystem in which flow of food takes place through many directions such as forest. A food web which is present in forest ecosystem is a highly complex and permanent (stable) type of food web.



- As much as food web complexes are there as much ecosystem is permanent or stable, such type of ecosystem does not degenerate naturally and continues for longer time period.
- The ecosystems which have simple food webs are not more stable. It means that this type of food web can be finished at nay time. Any attack or cutting of plants can causes the destruction of while ecosystem e.g. Gondwana forest is converted into the desert by the activity of men. this is the example of desertification by men.

### DIFFERENCE BETWEEN FOOD CHAIN AND FOOD WEB

Food chain	Food web
1. Food chain is the straight single path of transfer of food energy in the ecosystem.	1. t consists of a number of inter – connected food chains through which food energy is passed in the ecosystem.
2. Members of higher trophic level feed upon a single type of organisms of lower trophic level.	2. Members of higher trophic level can feed as a number of alternative organisms of the lower trophic level.
	3. Presence of food web increases the stability of the ecosystem.

## 15.4 ECOLOGICAL PYRAMIDS :

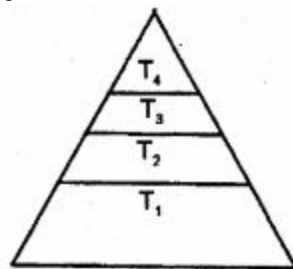
An ecological pyramid is a graphical representation of an ecological parameter like number of individuals or amount of biomass or amount of energy present in various trophic levels of a food chain with producers forming the base and top carnivores from the tip. Ecological pyramids could be upright, inverted or spindle shaped. There are three important parameters of each trophic level in a food chain i.e. number of individual, amount of biomass and amount of energy.

#### 15.4 (a) Pyramid of Number :

In this type of pyramid the number of individual organisms in various trophic levels is shown. These pyramids may be upright or inverted. The number of organisms of any trophic level depends upon the availability of organisms which are used as food on lower level so that availability of food is the main factor. These producers are of two types :

(i) **Phytoplanktons** : They are the inactive floating plant, because they do not have locomotors organs **e.g.** Diatoms.

(ii) **Phytonektons** : These plants swim actively in water, because in them locomotary organs are present. Usually flagella are present in these plants. **e.g.** Chamydomonas and dinoflagellates. The number of phytoplanktons and phytonketons are higher per unit area of water because they are unicellular.



Producers

#### Pyramid of Number in Aquatic Ecosystem

- In a tree ecosystem the pyramid of number is inverted. This is called as **parasitic ecosystem** because bird depend upon tree and parasites depend upon birds. Therefore with the increase in the number of trophic levels, the number of the organisms increases sequentially.



**Pyramid of number in tree ecosystem**

- Pyramid of number shows biotic potential of an ecosystem.
- The number of members of any particular species in a favorable condition is called as their **biotic potential**.
- When the number of the members of any species increases then it is called as **population explosion**.

#### **15.4 (d) Pyramid of Biomass :**

The biomass of each trophic level is shown by this pyramid. Mostly these pyramids are also upright (erect). e.g. Tree ecosystem.

- Pyramid of biomass in **aquatic ecosystem** is **inverted**, because in this producers are micro organisms and their biomass is lesser than other trophic levels.
- Pyramids of biomass show the standing crop of ecosystem. It means total amount of living matter at a particular time in an ecosystem is called as **standing crop**.
- Total amount of nonliving matter in an ecosystem is called as **standing state**.

#### **15.4 (c) Pyramid of Energy :**

It always remains erect, because flow of energy is not cyclic. i.e. during the flow of energy at each trophic level goes on decreasing.

- According to the **10% law of Linderman** the 90% part of

obtained energy of each organism is utilized in their various metabolic activities and only 10% energy transferred to the next trophic level. So that 90% energy is lost at each trophic level therefore, top consumers like lion etc., are weakest ecologically.

- Pyramids of energy show the productivity of any ecosystem.
  - **Plant community** : All types of plants present at a particular place to form a community, is called as plant community. The distribution of any species at a place depends upon social nature of the species which indicates cooperation between them.
  - **Synecology** : The ecological study of any plant community is called as “**gynecology**”.
  - **Phytosociology** : The study of structure of plant community is known as “**phytosociology**”
    - **Phytogeography** : The study of distribution of the plants on the earth is called as “**phytogeography**”. Some characteristics of plant community are as follows :
      - (i) **Species diversity** : There are many varieties of organisms found in a community. The total number of species of plants called as **population**. The ecological study of population is called as **Autecology**'s. The maximum species diversity is found in **tropical forest**. The plants are called as **flora** and animals are termed as **fauna**. The lowest species diversity is found in **Tundra biome or Arctic desert**.
      - (ii) **Dominant species** : The highest number of plants of a species present in a community is called as dominant species and whole plant community is known as the name of the species. Such as **Prosop is community on Aravali hills** and **Aravali hills** and **Pinus community on Himalaya**.



- **B.O.D.** It shows the deficiency of oxygen in the water. Daphnia is the indicator of B.O.D.

## 15.5 OZONE LAYER DEPLETION :

Between 20 and 26 km above the sea level ozone layer is present and the part of atmosphere containing it is called ozonosphere (Stratosphere). This layer is established due to an equilibrium between photo dissociation of ozone by UV - radiations and regeneration of ozone. The thickness of this ozonosphere averages 5 km. The ozone layer acts as an ozone shield and absorbs the harmful UV - radiations of the sunlight so protect the earth's biota from the harmful effects of strong UV - radiations. So this layer is very important for the survival and existence of life on earth.

### 15.5 (a) Causes of Thinning of Ozone Layer :

The decline in spring - layer thickness is called ozone hole. Ozone hole is largest over Antarctica and was just short of 27 million sq. km. during September 2003. Main chemicals to be responsible for destruction of ozone - layer are : chlorofluorocarbons (CFCs), halogens (used in fire extinguishers), methane and nitrous oxide. Out of these, most damaging is the effect of CFCs which are a group of synthetic chemicals and are used as collants in refrigerators are a group of synthetic chemicals and are used as collants in refrigerators and air conditioners; as cleaning solvents, propellants and sterilant etc. These CFCs produce “active chlorine” in the presence of UV - radiations. These active chlorine radicals catalytically destroy ozone and convert it into oxygen. Ozone at the higher levels of the atmosphere is a product of UV radiation acting on oxygen (O<sub>2</sub>) molecule. The higher energy UV radiations split apart some molecular oxygen (O<sub>2</sub>) into free oxygen (O) atoms. These atoms then combine with the molecular oxygen to form ozone as shown -



In 1987, the United National Environment Programme (UNEP)

succeeded in forging an agreement to freeze CFC production at 1986 levels.,

- **Nitrous oxide:** is produced in industrial processes, forest fires, solid waste disposal, spraying of insecticides and pesticides, etc. Methane and nitrous oxide also cause ozone destruction.

### **15.5 (b) Effects of Ozone Layer Depletion :**

The thinning of ozone layer results in increase in the UV radiation (in the range of 290 - 320 nm) reaching the earth's surface. It is estimated that 5 percent loss of ozone results in 10 per cent increase in UV - radiations. These UV - radiations can :

- (i) Increases in incidences of cataract and skin cancer.
- (ii) Decrease in the functioning of immune system.
- (iii) Inhibit photosynthesis in most of phytoplankton so adversely affecting the food chains of aquatic ecosystems.
- (iv) Damage nucleic acids of the living organisms.

## **15.6 MANAGEMENT OF NATURAL RESOURCES :**

### **15.6 (a) Introduction :**

We often hear or read about environmental problems. These are often global-level problems and we feel helpless to make any changes. There are international laws and regulations, and then there are our own national laws and acts for environmental protection. There are national and international organisations also working towards protecting our environment. The multi crore project of **Ganga Action Plan** came about in 1985 because the quality of water in the ganga was so poor.

## 15.6 (b) Pollution of the Ganga:

The Ganga runs its course of over 2500 km from Gangotri in the Himalayas to Ganga Sagar in the Bay of Bengal. It is being turned into a drain by more than a hundred towns and cities in Uttar Pradesh, Bihar and West Bengal that pour their garbage and excreta into it. Largely untreated sewage is dumped into the Ganga every day. In addition pollution is caused by other human activities like bathing, washing of clothes and immersion of ashes or unburnt matter also. And then, industries contribute chemical effluents to the Ganga's pollution load and the toxicity kills fishes in large section of the river.

### • **Three R's to save the environment :**

**(i) Reduce :** This means 'to use less'. We can save electricity by switching off unnecessary lights and fans. We can save water by repairing leaky taps.

**(ii) Recycle :** This means that we can collect plastic, paper, glass and metal items and recycle these materials to make required things instead of synthesizing or extracting fresh plastic, paper, glass or metal. In order to recycle, we first need to segregate our waste so that the material that can be recycled is not dumped along with other waste.

**(iii) Reuse :** This is actually even better than recycling because the process of recycling uses some energy. In the 'reuse' strategy, we can simply use things again and again.

## 15.6 (c) need of Manage Our Resources :

Our natural resources are limited with the rapid increase in human population. Due to improvement in health care, the demand for all resources is also increasing. Management of natural resources requires long term perspective to meet the needs and aspirations of future generations. Natural resources should be managed in such a way that every one of the society is benefited from its development. The waste generated from exploration of natural resources should be disposed off safely. For instance, mining causes pollution due to discard of large amount of slag during metal extraction.

## **15.7 SUSTAINABLE DEVELOPMENT :**

It is the development which can be maintained for a long time without undue damage to the environment. The objective of sustainable development is to provide the economic well being of the present and the future generations and to maintain a healthy environment and life support system. It encourage forms of growth that meet current basic human needs, thus sustainable development implies a change in all aspects of life. It depend upon the willingness of the people to change their perceptions of the socio economic environmental conditions and use of natural resources.

## **15.8 BIODIVERSITY :**

It is the existence of a wide variety of species of plants, animals and microorganism in a natural habitant within a particular environment. Biodiversity of an area is the number of species or range of different life forms found there. Forests are ‘biodiversity hotspots’.

## **15.9 PRACTICES FOR CONSERVATION AND PROTECTION OF ENVIRONMENT :**

Conservation means ‘to keep safe’ whereas preservation means ‘to maintain the environment at it is’. Various practices which can help in conserving and protecting our environment are as follows :

- The practice of crop rotation helps in conserving soil.
  - Judicious use of fertilizers, intensive cropping, proper irrigating and drainage help in the conservation of soil.
  - The treatment of sewage prevents pollution of water bodies and helps in conserving fishes and other aquatic life forms.
  - National parks and wildlife sanctuaries should e established throughout the country in order to protect and conserve will animals, birds and plant species.
  - New trees should be planted in place of those cut for various purposes, which will protect the earth from excessive heating.

- Harvesting of rain helps in the conservation of groundwater.
- Composting of solid organic waste for biogas and manure.

### **15.10 WILDLIFE :**

It means all those naturally occurring animals, plants and their species which are not cultivated, domesticated and tamed.

#### **15.10 (a) Conservation :**

It is the sensible use of the earth's natural resources in order to avoid excessive degradation and betterment of the environment. It includes - the search for alternative food and fuel supplies when these are endangered, an awareness of the dangers of pollution and the maintenance and preservation of habitats and its biodiversity.

##### **(i) Steps for conservation of wildlife :**

**(A)** Laws should be imposed to ban poaching or capturing of any animal or bird belonging to an endangered species.

**(B)** The natural habitats of wild animals and birds should be preserved by establishing National Parks, Sanctuaries and Biosphere reserves throughout the country.

**(C)** The Government Department should conduct periodic surveys of National Parks, Sanctuaries and Biosphere Reserves to have a knowledge of all the species of wild animals and birds.

**(D)** More attention should be given to conserve the endangered species of wild animals and birds to prevent their extinction.

**(E)** Unauthorized cutting of forest trees should be stopped.

### **15.11 STAKEHOLDERS OF FORESTS :**

The conservation of forests depend on its forest resources or its various stakeholder, who are as follows :

#### **15.11 (a) People Who Live in or Around Forests :**

- (i) They depend on forest produce, for various aspects of their life.
- (ii) The local people need large quantities of firewood, small timber.
- (iii) Bamboo is used to make slats for huts and baskets for collecting and storing food.
- (iv) Implements for agriculture, fishing and hunting are largely made of wood.
- (v) People collect fruits, nuts and medicines from forests, their cattle also graze in forest.

### **15.11 (b) Forest Department of the Government :**

- (i) Which owns the land and controls the forest resources.
- (ii) People develop practices to ensure that forest resources are used in a sustainable manner.
- (iii) The forest resources were overexploited after the British took control of the forest.
  - (iv) Forest department of independent India then owned the land and control the resources of the forest but local needs such as herbs, fruits and fodder were ignored.
  - (v) Monoculture of pine, teak or eucalyptus have been started which can destroy the bio-diversity of the area.

### **15.11 (c) Industrialist :**

- (i) Industries consider the forest as a source of raw material for its factories.
- (ii) These industries are not interested for the sustainability of the forest in one area as they go to a different area after cutting down all tree in one area.

### **15.11 (d) Wildlife and Nature Enthusiasts :**

- (i) They are not dependent of the forest but conserve nature and take part in its management.
- (ii) Conservationists started with conserving large animals but are now preserving biodiversity as a whole.
  - (iii) The local people, for instance the Bishnoi community in Rajasthan worked for conservation of forest and wildlife as a religious act. Thus management of forest resources has to take the interests of various stakeholder into account.

### **15.12 TRADITIONAL USE OF FOREST :**

- Alpine grasslands in Himalayas were grazed by sheep in summer.

- Nomadic shepherd drove their flock every summer in this area.

### **15.12 (c) Causes of Damages to Forests :**

- (i) Local people damage forest to fulfill their daily needs.
- (ii) Deforestation caused by industrial needs.
- (iii) Deforestation caused for development projects like building roads or dams.
- (iv) By tourists or in making arrangements for tourists.

### **15.12 (b) Conservation of Forests :**

- **it includes the following methods :**

(i) **Afforestation** . It is the practice of transforming an area into forest have not grown there, it involves

three types of forestry programmes.

(A) **Social and Environmental forestry**. It involves raising of trees for firewood, fodder and agricultural implements for the benefit of rural and tribal community.

(B) **Agro forestry**. It is an absolute commercial forestry developed to fulfill the need of various forest based industries. It is done on the fallow land or free-grazing lands.

(C) **Urban forestry**. It involves growing of ornamental trees along roads, vacant lands and common parts of urban areas.

(ii) **People participation in forest management :**

(A) The Sal forests in West Bengal got reduced alarmingly in 1972.

(B) Surveillance and policing to protect resulted frequent clash between forest official and the villagers.

(C) The department then changed its strategy and in Asabari forest, villagers were involved in

protection of the badly damaged Sal forest.

(D) In return, villagers were given employment and were allowed to collect firewood and fodder at

nominal fee.



(E) By 1983, the Asabari forest showed a remarkable recovery.

**(iii) Economic growth and Ecological conservation :**

(A) Forest resources should be used in an environmentally and developmentally sound manner.

(B) The benefit of controlled exploitation of resources goes to the people and the environment is also preserved.

(C) If the exploitation is too high, economic and social development will be faster but the environment will further deteriorate.

(D) We should use natural resources cautiously so that economic growth and ecological conservation go hand in hand.

(E) **Amrtia Devi Bishnoi National Award.** In 1731, Amrita Devi Bishnoi sacrificed her life along with 63 persons for the protection of 'Khejri' trees in Khejrli village near Jodhpur in Rajasthan. In the memory Government of India have recently instituted this award for Wildlife Conservation.'

(F) **Chipko Movement :** During 1970, In Reni village of Garhwal, a contractor was allowed to cut trees in a forest near the village. When the contractor's workers went to the forest to cut trees the woman of the village hug the tree trunks to prevent the workers from cutting trees, Chipko means 'hug' and the movement started by the villagers by hugging trees is called **Chipko Andolan**'.

**15.13 WATER AS A BASIC NATURAL RESOURCE :**

- It is a valuable national asset.
- It is the main requirement of human being.
- Water is of two types - salt water and fresh water.
  - Fresh water is an unlimited natural resource, it can be obtained from three natural resources - rain water, surface water and ground water.
- Human intervention pollutes water and also changes the availability of water in various regions.

**15.13 (a) Water Sources :**

- (i) Rain in India is due to monsoon.

(ii) Failure to sustain underground water due to loss of vegetative cover, development of water demanding crop and pollution from industrial effluents.

(iii) Small dams, canals and tank were used for irrigation purpose and to fulfill the basic minimum needs.

(iv) Large dams and canals were made by British as well as our own government.

(v) Due to the mega project, local irrigation methods got neglected and the local people lost control over management of local water sources.

(vi) Large dams and canals were made by British as well as our own government.

### **13.13 (b) Management of Water Resources :**

It includes :

(i) Interacted water-shed plan for drinking, irrigation and industrial uses.

(ii) Flood control

(iii) Transfer of surplus water to water deficit basins by inter-linking of rivers.

(iv) Hydro geological survey to identify over-exploited areas.

(v) Artificial recharging of the ground water.

(vi) Mass awareness programmes through public or private agencies.

(vii) **Dams** : They are massive barriers built across rivers and streams to confine and utilize the flow of water for human purposes such as irrigation and generation of electricity.

- Large dams can also ensure the storage of adequate water.
- Canal system leading from dams transfer large quantity of water upto great distances, e.g. Indira Gandhi Canal or Rajasthan brought greenery to considerable areas.
- **Purposes for building a dam :**
- Generation of electricity

- Irrigation
- Control of flood which either stops or slows the amount of water in the river.
- **Criticism about large dams :**
- **Social problems :** They displace large number of farmers and tribals.
- **Economic problems :** They consume huge amount of public money without proportionate benefit.
- **Environmental problems.** As they cause deforestation and loss of biological diversity.

### 15.13 (c) Mismanagement of Water Distribution :

Due to mismanagement in distribution of water, the benefit of constructing a dam goes to few people only. **For example**, people close to the water source grow water intensive crop like sugarcane and rice while people farther downstream do not get any water. This resulted in discontentment among the people who has been displaced by building of dam.

**(i) Watershed management :** It means scientific conservation of soil and water to increase the biomass production.

- Watershed management not only increases the production and income of the watershed community but also overcomes drought and flood.
- It increases the life of downstream dam and reservoirs.

**(ii) Water harvesting :** It means capturing rainwater where it falls or capturing the runoff water in a local area and taking measures to keep the water clean by not allowing polluting activities to take place.

**(A) Techniques of water harvesting :** Water harvesting techniques are mainly location specific. It is an age - old concept in India.

- Khadins, tanks and nadis in Rajasthan.
- Bandharas and tals in Maharashtra
- Ahars and Pynes in Bihar
- Kulhs in Himanchal Pradesh
- Ponds in kandi belt of Jammu.
- Eris (tanks) in Tamilnadu.
- Suragams in kerala.
- Kattas in Karnataka.
- Due to own control of the local population over exploitation of the local water resources in reduced.

**(B) Some of the water harvesting techniques are :**

- Capturing of runoff water roof tops.
- Capturing of runoff water from local catchments.
- Capturing seasonal flood water from local streams.

**(C) Benefits of water harvesting :**

- Provide drinking water.
- Provide irrigation water.
- Increase in ground water resources.
- Reduces storm water discharge, urban flood and overloading of sewage treatment plants.

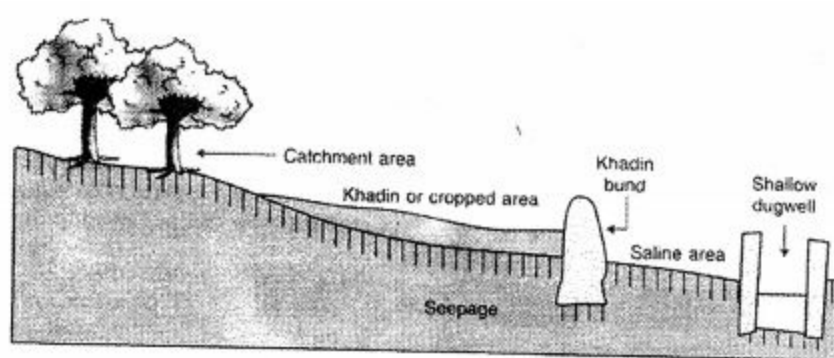
**(D) Advantages of ground water :**

- It does not evaporate.
- It spreads out to recharge wells.
- It provides moisture for vegetation.
- It does not provide breeding grounds for mosquitoes.
- It is relatively protected from contamination by human and animal

waste.

### **(E) Traditional water harvesting system :**

- The water harvesting structures are mainly crescent shaped.
- Monsoon rains fill ponds behind the structures.
- The large structure hold water throughout the year while most dry up after monsoon.
- The main purpose of this system is to recharge the ground water and not to hold surface water.



### **Traditional water harvesting system**

#### **15.14 FOSSIL FUELS :**

These fuels are obtained from the remain of plants and animals, which got buried beneath the earth millions of years ago, changed into coal, petroleum and natural gas due to excessive heat and high pressure inside

the earth.

### **15.14 (a) Non-Renewable Energy Sources :**

These are energy sources which cannot be replaced easily when they get exhausted and are also called conventional sources of energy. They are used traditionally for many years and take millions of years to form **e.g. Fossil fuels.**

**(i) Coal :** It contains carbon and its compound mainly with nitrogen, oxygen, sulphur and hydrogen. It also consists of inorganic matter.

**(ii) Petroleum :** 'Petro' means rocks and 'oleum' means oil, petroleum is therefore the oil found in rocks. It is a complex mixture of solid, liquid and gaseous hydrocarbons. It also contains small amounts of other compounds of carbon, hydrogen, oxygen, nitrogen and sulphur. Large reservoirs of petroleum have been preserved by nature for millions of years between porous rocks beneath the earth.

### **15.14 (b) Formation of Non-Renewable Energy Sources :**

**(i) Formation of coal.** Coal is formed from organic matter which got buried under the earth 300 million years ago. Due to high pressure and temperature inside the earth, this organic matter changed into coal, that is why, coal is called fossil fuel.

**(ii) Formation of petroleum.** It is formed by the decay of very small (tiny) marine animals and plants buried under the earth about 400 million years ago. Due to excess of heat and pressure it changed into oil called petroleum. It is a fossil fuel.

### **15.14 (c) Conservation of Coal and Petroleum :**

It means more efficient use with regard to economic, social and environmental cost and benefits which result in attainment of higher efficiency, minimisation of wastage and protection of the environment.

- We can conserve coal and petroleum by their judicious use and substituting them by other resources wherever feasible. Conservation of coal and petroleum is a joint responsibility of the industries, citizens and

government where each one has significant role in Management of Natural Resources.

#### **15.14 (d) Necessity of Judicious Use of Coal and Petroleum :**

The fossil fuels, coal and petroleum get exhausted and their combustion pollutes our environment, so a judicious use of these resources is necessary. When combustion take place, oxides of carbon, hydrogen, nitrogen and sulphur are formed. Carbon monoxide is formed instead of carbon dioxide if there is insufficient are. The oxides of sulphur, nitrogen and carbon monoxide are poisonous at high concentrations. Carbon dioxide is a green-house gas which leads to global warming.

#### **15.14 (e) Uses of Fossil Fuels :**

- (i) In thermal power plants and steam engines.
- (ii) Petroleum products like petrol and diesel are used as fuel in motor vehicles and ships. Other products like kerosene and LPG are used for cooking purpose.

#### **15.14 (f) Management of Fossil Fuels :**

The natural gas is a good alternative to fossil fuels like coal and petroleum. The use of alternative source of non-conventional energy such as solar energy, which energy, biomass energy, etc., should be promoted to save the reserves of fossil fuels. Biogas can also be used for various purposes.

## DAILY PRACTICE PROBLEMS # 15

### OBJECTIVE QUESTIONS

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1. Ecosystem term was coined by  
(A) Odum (B) Mishra (C) Reiter (D) Tansley
2. Pyramids of biomass are  
(A) upright or inverted (B) always inverted (C) mostly upright (D) mostly inverted
3. Vultures in an ecosystem are  
(A) predators (B) scavengers (C) consumers (D) top carnivores
4. In which of the following trophic levels in any ecosystem the maximum energy is stored ?  
(A) Producers (B) Herbivores (C) Carnivores (D) Top carnivores
5. In an ecosystem the  
(A) primary producers are more than that of primary consumers  
(B) secondary consumers are largest, because they are powerful  
(C) primary consumers are out of number  
(D) primary consumers are least dependent upon primary producers
6. In an ecosystem the function of the produces is to  
(A) convert organic compounds into inorganic compounds  
(B) trap solar energy and convert in into chemical energy  
(C) utilize chemical energy  
(D) release energy
7. The importance of ecosystem lies in  
(A) flow of energy (B) cycling of materials (C) both of the above (D) none of the above
8. In other to maintain proper ecological balance  
(A) the existing forests should be cleared and new ones should be



planted

(B) some quick growing annuals should be planted if a tree must be cut for other uses

(C) tree must be cut whenever necessary because the underground part performs the useful purpose

(D) a tree should be planted in place of one to be cut

**9.** A biosphere is composed of

(A) living organisms

(B) living organisms and lithosphere

(C) living organisms, lithosphere and atmosphere

(D) living organisms, lithosphere, atmosphere and hydrosphere

**10.** Pyramid of energy in a forest ecosystem is

(A) always inverted                      (B) always upright

(C) both upright and inverted              (D) first upright then inverted

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## SUBJECTIVE QUESTIONS

### SHORT ANSWER TYPE QUESTIONS

1. How is ozone formed in the stratosphere ?
2. What is the function of ozone layer ?
3. Write a note on ozone depletion.
4. What is the significance of wildlife ?
5. What are fossil fuels ?

### LONG ANSWER TYPE QUESTIONS

6. What is ecosystem ? Explain the food chain and food web.
7. Explain the different components of ecosystem.
8. What is meant by management and conservation of natural resources ?
9. What is significance of biodiversity ?
10. What is the name of the award given in honour of the movement started for protection of 'Khejri' trees ?
11. Why is the management of forest and wildlife resource considered as a challenging task ?

## ANSWERS

### DAILY PRACTICE PROBLEMS # 15

Que.	1	2	3	4	5	6	7	8	9	10
Ans.	D	A	B	A	A	B	C	D	D	B

# ORIGIN AND ECOLUTION OF LIFE

## 16.1 INTRODUCTION :

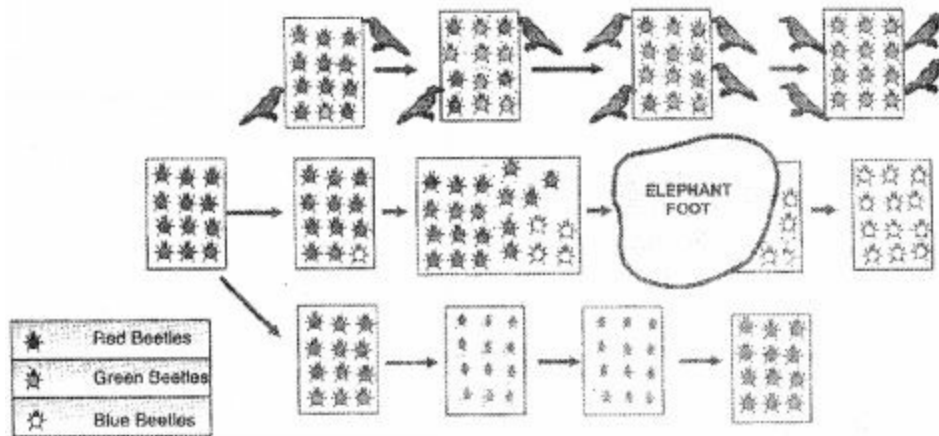
All living organisms have arisen through the evolutionary process and show diversity, yet some similarities exist among them. e.g. Amphibians, reptiles and mammals have limbs for locomotion in water, fishes have fins for swimming in water and birds have wings for flying.

- A close examination reveals that the limb, fins and wings are formed on the same basic structural plan.
  - All such examples can be explained if we consider that the diverse groups of organisms share a common ancestor from who they have diverged and formed two different species. Such process of change in biological system is called as **evolution**.
  - The Doctrine of the **Organic Evolution** state that the organisms existing at present are the descendants of much simpler ancestors.

## 16.2 EVOLUTION :

The term '**Evolution**' means "**unrolling or unfolding**" change from one condition to another. It means members of a species change generation after generation with environmental requirements to turn into better organized and more complex new species. The changes in the properties of population of organisms or groups of such populations over the course of generations are considered as organic evolution. It is a process of cumulative change of living populations and in the descendant populations of organisms. In other words, it is "**descent with modifications.**" Evolution is a change in the genetic composition of a population. There is an inbuilt tendency of variation during

reproduction, both because of errors in DNA copying and as a result of sexual reproduction.



Variations in a population –inherited and otherwise

- **Illustration.** Let us consider a group of twelve red beetles, which reproduce by sexual reproduction and lives in the bushes with green leaves. They are preyed upon by crows. As we know that more the crows eat, the fewer beetles are available to reproduce. Now let us consider various causes of variation in the population of red beetles.

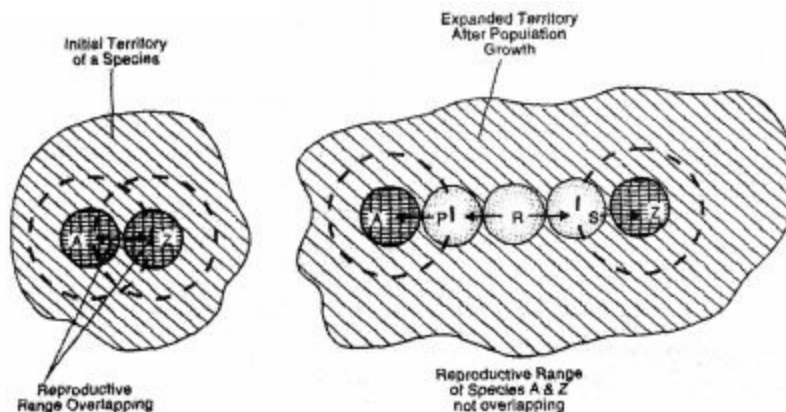
- **Case I.** The process of sexual reproduction results in the formation of few green beetles instead of red beetles. These green beetles were able to pass the colour on to its progeny, so that all its progeny beetles are green. These green beetles cannot be seen by crows so, they are not eaten. As a result, with passage of time there will be more number of green beetles than red beetles. In this case, natural selection is directing evolution in the beetle population. The natural selection is exerted by the crows. The more crows there are, the more red beetles would be eaten and more the proportion of green beetles in the population would be. So, natural selection brings about improved adaptive relative between organisms and environment by favouring the reproduction and survival of those individuals which are found more suited to the given environment.

- **Case II** The process of reproduction again results in the formation of another colour variant i.e., blue colour beetles. These beetles were also able to pass the colour on to its progeny, so that all its progeny beetles are blue. These beetles can be seen by crows, so they are eaten. In initial stages there are more number of red beetles in comparison to blue beetles in a population. But at this point, an elephant comes by and stamps on the bushes where the beetles live. This kills most of the beetles. But by chance few beetles that have survived are mostly blue. These beetles (blue) will now slowly increase their number. In this case, the colour change gave no survival advantage. It is simply a matter of accident survival of beetles of one colour that changed the common characteristics of the resultant population. The elephant would not have caused such major havoc in the beetle population if the beetle population had been very large. This random change in the gene frequency occurring by chance irrespective of its being beneficial or harmful is called genetic drift. For this reason, in small population, some unfavourable characters may also be fixed or beneficial characters may be lost.

- **Case III.** In this case, beetle population goes on increasing

but, the bushes start suffering from a plant disease. The amount of leaf material for the beetles is reduced so that average weight of adult beetles is reduced. The average weight of adult beetles decreases because of scarcity of food. After a few years, when bushes once again become healthy due to the absence of disease, then the average weight of beetles should once again increase, due to adequate availability of food.

### 16.3 SPECIATION :



- **Speciation is Origin of New Species** : A species comprises of several populations. Interbreeding is very frequent among the individuals of a population and is occasional among the populations of a species whereas interbreeding is absent among the individuals of different species. There is a free gene flow within the members of a population and a free gene flow could be maintained among the members of different population of a species, provide an opportunity to interbreed. But free gene flow between two species does not occur on account of marked difference in their genotype, it means new species arise by the establishment of reproductive isolation (intrinsic barrier to interbreeding of natural population)

The separation of species populations in due course of time

Consider that beetle population has become very large and has spread over a mountain range. The individual beetles feed mostly on a few nearby bushes throughout their life time. So, in this huge population of beetles, there will be sub-populations in neighborhood. The process of reproduction will occur mostly within these sub populations or rarely between two different sub-populations. So, gene flow will take place between two different sub populations. If, however between two such sub-populations a large river or a creeping glacier or a mountain cut develops then the two populations will be further isolated. The levels of gene flow will further decrease between two populations. Over generations the process of natural selection and genetic drift will further isolate two sub-populations of beetles. Now, members of these two sub-groups will be incapable of reproducing even after they meet each other.

There can be a number of ways by which interbreeding between two beetles of two subgroups stop. The changes in DNA structure or number of chromosomes will make the gametes incompatible and prevent fertilization. The morphology of reproductive organs may change, which prevents compatibility and fertilization. The difference in the Behaviour of male and female will also prevent mating. The organisms may have developed different breeding periods.

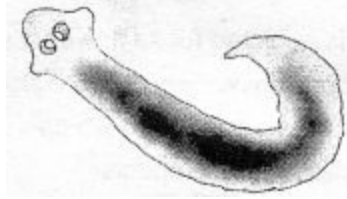
### **16.3 (d) Evolution by Stage:**

The evolution in an organism or its organs from simple to complex forms has taken place in stages. It has taken bit by bit over generation. The evolution cannot take place by a single DNA change. Let us take few examples.

(i) Feathers were firstly developed in dinosaurs, but they could not fly. Probably, it was developed to provide insulation in cold weather. Later on feathers developed in birds, where they were used for



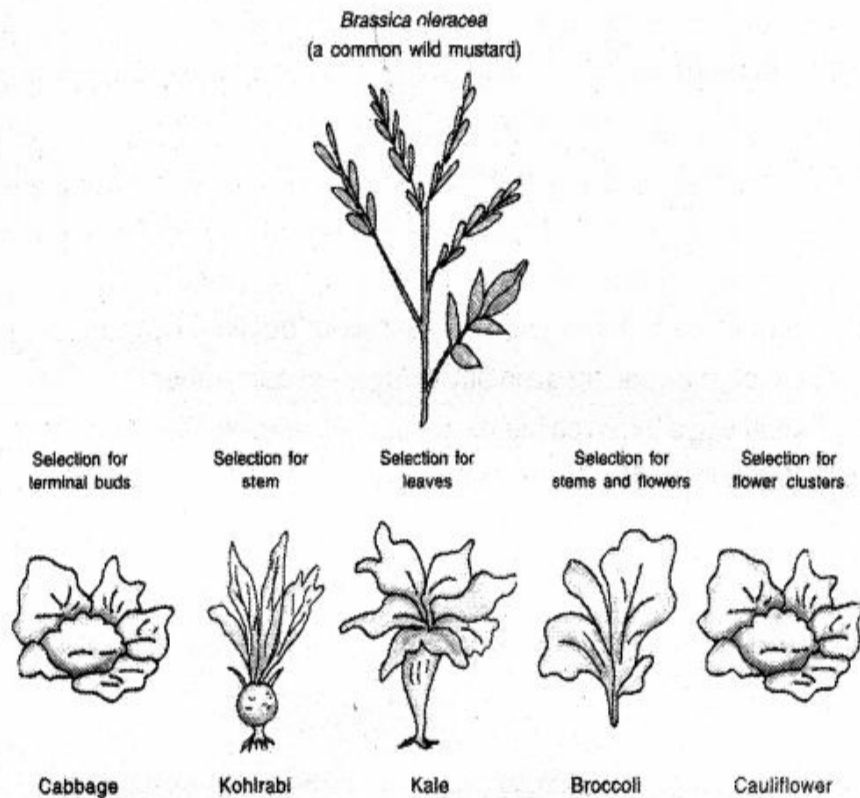
flight. This indicates that birds are closely related to reptiles (dinosaurs were reptiles). Also indicates that the character which developed for one function is later on used for different function.



(ii) Eyes for the first time developed in Planaria. Rudimentary eyes present in Planaria and just photosensitive eyespots. Simple as well as compound eyes have developed in insects and crustaceans. Eyes have also developed in Octopus and vertebrates. The structure of the eye in each of these organisms is different enough for them to have separate evolutionary origins.

Planarian has very simple eyes

(iii) Man has been taking the advantage of genetic variations for improving the qualities of domesticated plants and animals. He selected the individuals with desired characters and separates them from those which do not have such characters. The selected individual are interbred. This process is termed as artificial selection. If it is repeated for many generations it produces a new breed with desired characters.



Some crop plants produced by selective breeding

(iv) By this selections process, very dissimilar looking structures may evolve from a common ancestral design. One of the classical examples is wild cabbage plant. Humans have cultivated wild cabbage as a food plant, and generated different vegetables from it by selection even more than two thousand years ago. The various crop plants developed from wild cabbage plants are :

- **Cabbage** : it is selected for its terminal buds, where there is a very short distance between leaves.
- **Kohlrabi** : It is selected for its swollen stem position.
- **Broccoli** : It is selected for its flowers (arrested flower development) and stem.

- **Cauliflower:** it is selected for its flower cluster (sterile flowers). The other way of tracing evolutionary relationship depend on the changes in DNA during reproduction. If we compare the DNA of different species then we can directly estimate how much DNA has changed during the formation of these species.

## 16.4 ORIGIN OF LIFE :

Several theories have been put forward to explain the origin of life.

### 16.4 (a) Theory of Special Creation :

According to this theory life was created by some **Super Natural Power (God)**. This theory has not evidence, hence it is a rejected theory.

### 16.4 (b) Theory of Spontaneous Generation :

According to this theory life is originated repeatedly from nonliving materials, automatically from time to time. This theory was supported by **Thales** and **Aristotle**.

### 16.4 (c) Theory of Biogenesis :

Scientist like **Redi**, **Lazzaro Spillanzani**, **Louis Pasteur** proposed and proved the biogenesis concept of **Huxley** and **Harvey** that new organism arises from pre-existing ones.

### 16.4 (d) Cosmozoic Theory :

It states that, life came to earth from some heavenly bodies in the form of spores and seeds.

### 16.4 (e) Modern Theory (Naturalistic Theory) :

Life originated upon earth by a long series of physiochemical changes which brought about a gradual evolution of first inorganic and then organic compounds (chemical evolution). It results in the formation of protoplasm. This includes -

- (i) **Oparin - Haldane Theory.**

- It independently proposed the origin of life by chemical evolution.
- Oparin's views were later on published in his book "**The origin of life**".

- According to this theory earth was formed about 4600 million years ago. The atoms of nitrogen, hydrogen, oxygen, argon, carbon etc. formed the primitive atmosphere.

- The atmosphere was reducing because hydrogen atoms were most numerous and most reactive in the primitive atmosphere.

- As, the earth began to cool, it's matter began to condense. But still it was so hot that water could exist only in vapour form.

- Large quantities of  $H_2$ ,  $N_2$ , water vapours,  $CH_4$  and  $NH_3$  were present, but free oxygen was not present in significant amount.

- Further fall in temperature allowed  $H_2O$  to remain in liquid form so that oceans and water bodies were formed containing large amounts of dissolved  $NH_3$ ,  $CH_4$ ,  $HCN$ , nitrides, carbides and various gases.

- Reacting with water and it's oxygen, simple saturated hydrocarbons such as  $CH_4$  formed unsaturated hydrocarbons like ethylene, acetylene. Later aldehydes, ketones, alcohols and organic acids were formed.

- Abundant energy was available in the form of heat, cosmic rays and lightening. Using this energy, the organic molecules of ocean water formed complex compounds like amino acids, sugar, glycerol, fatty acids, nitrogenous organic bases etc.

- These molecules further formed large linear polymers, or macromolecules like protein, carbohydrates, and fats, the oceanic water became a rich mixture of organic compound called "**Prebiotic soup**".

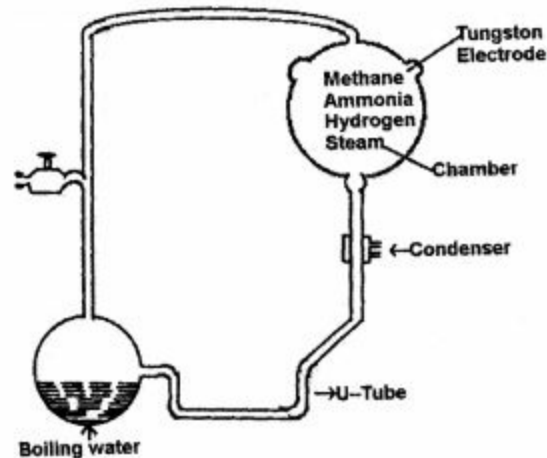
**(ii) Stanley Miller and H.C. Urey Experiment [Experiment for verification of prebiotic soup] :**

- This experiment verified the **Oparin Haldane theory** by creating [stimulating] in their laboratory the probable conditions on the primitive earth.

- They built an apparatus of glass tubes and flasks and created an atmosphere containing  $H_2$ ,  $CH_4$ ,  $NH_3$ ,  $H_2O$  in one chamber - energy was also supplied by electric sparks.

- The resultant mixtures were allowed to condense. Experiment was run for one week. Chemical composition of the liquid revealed **glycine, alanine** and **aspartic acid**.

- Thus biotic synthesis of organic molecules was confirmed



**Fig : Miller's Experiment**

## 16.5 ORGANIC EVOLUTION :

(i) Though life originated by chemical evolution on the primitive earth. It was later replaced by organic evolution.

(ii) Organic evaluation states “**Descent with modification**” i.e. present day complex living organism have evolved from earlier simpler organisms by small but gradual changes which have occurred over million of years.

(iii) Though living organisms show great diversity in size, structure, function, Behaviour etc. They also show basically similar metabolic process indicating some common ancestors.

## 16.6 FOSSILS :

- The plants and animals that lives in remote past have in many cases left proofs of their existence in the form of remains in the rocks. These are called as **fossils**.

- Paleontology **is the study of fossils**.
- **Leonardo-a-vinci** is called as the father of Paleontology.
- Founder of modern paleontology is **George Cuvier**.

### 16.6 (a) Fossils Can be of Three Different Types :

(i) **Petrified** : Replacement of some of the organic parts by mineral

deposits is called as **petrification**.

**(ii) Moulds and casts** : Moulds are hardened and fossilized mud that surrounds a dead organism. Sometimes the moulds are found with petrified fossils of the organisms and then they are called as **casts**.

**(iii) Prints** : Foot prints or prints of wings, skin, leaves, stem etc. made in soft mud which subsequently became fossilized.

### **16.6 (b) Dating of Fossils :**

It is also called as the “**clock of fossils**”. It is the process of determining the age of fossils. This include the following 3 methods.

(i) Lead method                      (ii) Radio Carbon method                      (iii)  
Potassium-Argon method

## How do fossils form layer by layer ?

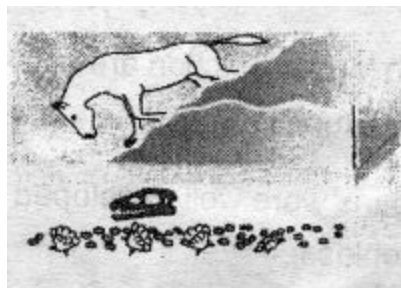
Let us start 100 million years ago. Some invertebrates on the sea bed die, and are buried in the sand. More sand accumulates, and sandstone forms under pressure.



Millions of years later, dinosaurs living in the area die, and their bodies, too, are buried in mud. This mud is also compressed into rock, above the rock containing the earlier invertebrate fossils.

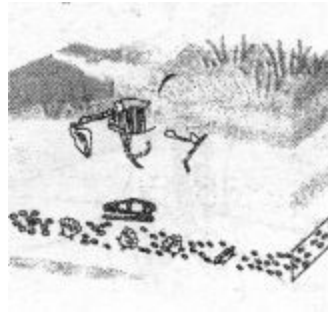


Again millions of years later, the bodies of horse-like creatures dying in the area are fossilized in rock above these earlier rocks.



Much later, erosion by, say, water flow ears away some of the rock and exposes the horse-like fossils. As we dig deeper, we will find older and older fossils.



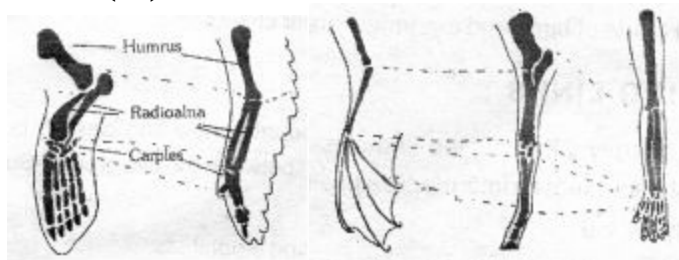


## 16.7 MORPHOLOGICAL EVIDENCES :

### 16.7 (a) Homologous Organs or Homology :

[Same structure but different function] Homology can be defined as the relationship between the structures which have similarity due to common ancestors, although these structures may show difference in their function. .e.

- (i) fore limbs of vertebrates having pentadactyl limbs of similar origin and similar arrangement of bones, muscles etc.
- (ii) Legs of different insects.
- (iii) Teeth of man.



**Man**

**Whale**

**birds**

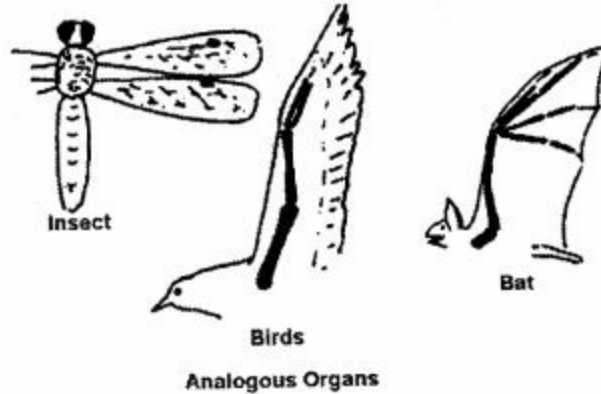
**Bat**

**Horse**

### 16.7 (b) Analogous Organs or Analogy :

[Different structure but similar function] Analogy can be defined as a relationship between structures, which though differ anatomically but would have superficial similarity due to similar function.

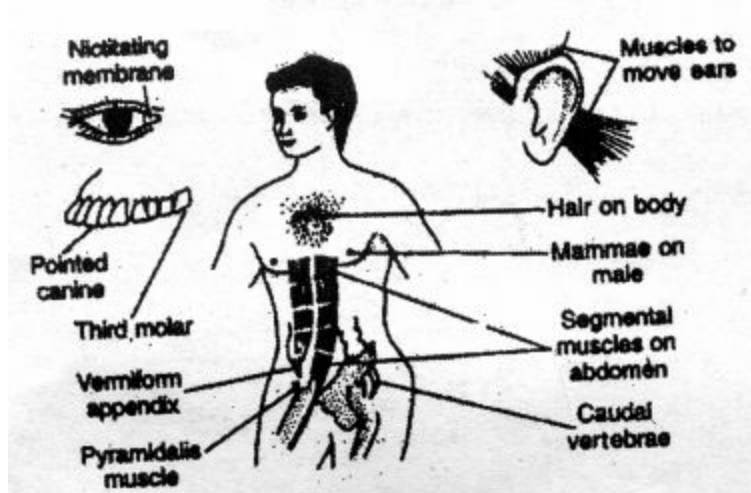
- e.g. (i) Wings of insects and wings of birds (ii) Sting of bee and scorpion.  
 (iii) Fin of fishes and flipper of whales.



### 16.7 (c) Vestigial organs :

Those organs which have no longer function are known as **vestigial organs**. These organs have reduced structurally as well as functionally.

- It appears that these organs were well developed in ancestors but due to their reduced or less use they became functionless.



Vestigial organs of man

- There are many vestigial organs in human body e.g.
  - (i) Vermiform appendix in man
  - (ii) External ear in man
  - (iii) Nictitating membrane
  - (iv) Wisdom teeth

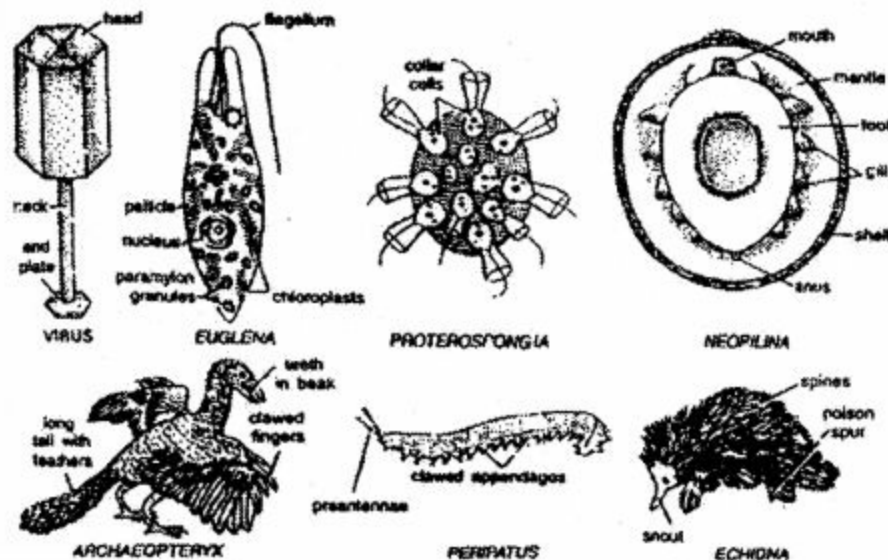
## 16.8 Common Ancestry and Inter-relationship :

- Various organisms are interconnected.
- Their resemblance suggest a common ancestry **e.g.**
- (i) Heart of fish is two chambered
- (ii) Heart of amphibian is three chambered
- (iii) Hearts of birds and mammals are four chambered

## 16.9 CONNECTING LINKS:

Animals are sharply differentiated and classified into phyla and classes but there are some existing animals which represent an intermediate position between the two groups. Such organisms are called as connecting links e.g.

- (i) Lung fish shows connection between fishes and amphibians.
- (ii) Amphibian show connecting links between fishes and reptiles.
- (iii) Virus shows connecting links between living and non-living.
- (iv) Euglena shows connecting link between and animals.
- (v) Protopongia between protozoa and porifera.



## 16.10 Embryological Evidences :

- Embryology can be defined as a branch of science that deals with study of

development of an organisms from zygote to an adult form inside the egg or mother's womb.

- The study of embryo's form various organisms reveals similarity in the early stages of embryo development and this theory suggests that these organisms have evolved from common ancestors.

**e.g.** Embryos of fish, tortoise, child, rabbits and man show the similarity during embryo development.

### **16.11 PALEONTOLOGICAL EVIDENCES :**

- Palaeontology is a branch of science that deals with the study of fossils.

- The study of fossils of some of the organisms show similarity between the two groups, e.g. Fossils of **Archaeopteryx** shows characteristics of both reptiles and birds.

### **16.12 EVIDENCES FROM ATAVISM (REVERSION) :**

Sometimes in some individuals such characters appear which were supposed to be present in their ancestors but were lost during the course of development. This phenomenon is known as **atavism or reversion**. Atavism proves that animals developing atavistic structures have evolved from such ancestors in which these structures were fully developed **e.g.**

(i) Human baby with tail

(ii) Cervical fistula

(iii) Long and pointed canine teeth represent carnivorous ancestors.

- (iv) Large and thick body hair reflect our relationship with apes.
- (v) Presence of extra nipples (more than two)

### **16.13 EVIDENCES FROM PHYSIOLOGY AND BIOCHEMISTRY :**

Different organisms show similarities in physiology and biochemistry. Some clear examples are-

**(i) Protoplasm :** Structural and chemical composition of protoplasm is same from protozoa o mammalia.

**(ii) Enzymes :** Enzymes perform same functions in all animals like trypsin digests protein from Amoeba to man, amylase digests starch from porifera to mammalia.

**(iii) Blood :** Chordates show almost same composition of blood.

**(iv) ATP:** This energy rich molecule is formed for biological oxidation in all animals.

**(v) Hormones :** Secreted in different vertebrates perform same functions.

**(vi) Hereditary material :** Hereditary material is DNA in all organisms and is basic structure is same in all animals.

**(vii) Cytochrome C:** It is a respiratory protein situated in the mitochondria of all organisms. Physiology and biochemistry thus prove that all animals have evolved from some common ancestor.

### **16.14 DARWINISM OR THEORY OF NATURAL SELECTION :**

“**Darwinism**” or Theory of natural selection was proposed jointly by **Charles Darwin** and **Alfred Wallace** in 1859. This theory was later on explained by **Charles Darwin** in his Book “**The origin of species**” by means of “**Natural Selection**” (1859)

#### **16.14 (a) Postulates of Darwinism :**

He had proposed six important postulates namely

- (i) Multiplication of individual of species in a geometric proportion.
- (ii) Existence of variation.

(iii) The operation of natural selection on the existing variability in order to select the best fitted variations.

(iv) Due to geometric multiplication and due to the availability of limited food and space for these

individuals the struggle for existence is seen. Since the requirement of the members of the same species would be similar, such a struggle would be more intense amongst the members of the same species.

(v) **Variations** : They are rule of nature and proved to be beneficial for between existence.

(vi) **Natural selection** : Natural selection is the principle element of Darwin's theory. The principle by

which the preservation of useful variations is brought about was called as **natural selection**.

#### **16.14 (b) Merit of Darwinism :**

(i) The major achievement of Darwin was to recognize one of the major factor in adaptation i.e. natural selection.

#### **16.14 (c) Demerits of Darwinism :**

(i) In Darwin's natural selection principle the death of the unit and the survival of the fittest was conceived.

(ii) Darwin's also believed that the natural selection operates on variations but he did not consider the possibility of the origin of new hereditary variations, which are really responsible for origin of species.

(iii) Darwin also did not distinguish between hereditary and environmental variations.

#### **16.14 (d) Neo-Darwinism :**

- It is a modified form of Darwinism, along with the recent researches of **Weisman, Mendel, Huxley, Gates, Devries** etc.
- They performed various experiments to remove objections against Darwin's Theory.
- **Neo - Darwinism comprises three important postulates :**

**(i) Genetic variability :** It means the variation that occur in the genetic constitution of an organism. They could be of following types :

**(A)** Chromosomal aberrations [deletion, duplication, translocation and inversion]

**(B)** Chromosomal numbers [haploidy, polyploidy etc.]

**(C)** Gene mutation

**(D)** Hybridization

**(ii) Natural selection :** According to Neo - Darwinism the organism which is more adapted towards environment matures first and produces more progenies, as compared to less adapted organism.

- It shows positive selection method.
- It can overcome environmental stress.
- It produces greater progeny than others

**(iii) Reproductive isolation :** it is the failure of interbreeding between the related groups of living organisms and is essential to prevent the dilution of differences between the genetically different species.

## **16.15 LAMARCKISM :**

First theory of evolution was proposed by **Jean Baptiste de Lamarck** (1744 - 1829) Book **Philosophie Zoologique** (1809). The term **Biology** was given by **Lamarck & Treviranus**.

### **16.15 (a) Basic Concepts of Lamarckism :**

**(i) Internal Vital Forces :** Some internal forces are present in all organisms. But the presence of these forces organisms have the tendency to increase the size of organs or entire body.

**(ii) Effect of environment and new needs :** Environment influences all types of organisms. Changing environment gives rise

to new needs. New needs or desires produce new structures and change habits of the organism.

**(iii) Use and disuse of organs :** If an organ is constantly used, it would be better developed whereas disuse of organ results in its degeneration.

**(vi) Inheritance of acquired characters :** During the life time of an organism new characters develop due to internal vital forces, effect of environment, new needs and use and disuse of organs. These acquired characters are inherited from one generation to another. By continuous inheritance through many generations these acquired characters tend to make new generation quite different from its ancestors resulting in the formation of new species.

• **Examples in support of Lamarckism :**

**(i)** Long neck and large fore limbs of Giraffe.

**(ii)** Aquatic birds stretch their toes and developed webs.

**(iii)** Snakes have lost their legs.

**(iv)** Deer become a good runner by the development of strong limbs and streamlined body.

**(v)** Retractable claws of carnivorous animals.

### **16.16 (b) Criticism of Lamarckism :**

**(i)** According to first concept organisms tends to increase their size but it is not a universally truth, e.g. Among angiosperms the trees seem to have been primitive and the shrubs, herbs and grasses evolved from trees but the size is reduced during evolution.

**(ii)** Second concept is false as we can't have a sprout wings wishing to fly like birds.

**(iii)** The third concept have some truth like the well developed biceps of black smith and less developed wings in flightless birds. But this concept also have many objection like the eyes of regular reader do not increase in size and power with increasing age, the constantly beating heart maintains a constant size through generations.

**(iv)** Forth concept is completely false because acquired characters are not inherited.



### **16.17 WEISMANN :**

Weismann cut off tails of rats for about twenty two generations but there is no reduction in the size of the tail. On the basis of this experiment Weismann proposed the **theory of continuity of germplasm.**

#### **16.17 (a) According to Weismann :**

- Two types of matters are present in organisms, somatoplasm and germplasm.
- Somatoplasm in somatic cells and germplasm in germinal cells.
  - Somatoplasm dies with the death of an organism while germplasm is transferred into next generation.
  - If any variation develops in germplasm it is inherited while if variation develops in somatoplasm it is not transmitted.

### **16.18 NEOLAMARCKISM :**

Although Lamarckism remained controversial but some scientists gave following evidences in favour of Lamarckism they are called as **neolamarckians.** According to neolamarckism environment affected the inheritance of acquired characters. According to it changing environment gives rise to some physical and chemical changes in organism which effect germplasm, and these acquired characters are definitely inherited.

## DAILY PRACTICE PROBLEMS # 16

### OBJECTIVE QUESTIONS

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- Which one of these is likely to have been absent in free form at the time of origin of life ?  
(A) Oxygen                      (B) Hydrogen                      (C) Ammonia                      (D) Methane
- The famous book “**Origin of Species**” was written by Charles Darwin in  
(A) 1809                      (B) 1859                      (C) 1885                      (D) 1871
- Charles Darwin toured in a ship for five years it was  
(A) Vikrant                      (B) Phillips                      (C) Alexander                      (D) Beagle
- The term evolution in Biology means that  
(A) fossils are old                      (B) life began in Sea  
(C) living things constantly change                      (D) none of the above
- The theory of Natural selection of Darwin to explain organic evolution was based on  
(A) modification in organs through used and disuse  
(B) probability of reproduction, struggle for existence and survival of the fittest  
(C) Inheritance of acquired characters  
(D) appearance of sudden large variations, then inheritance and survival of those having these variations
- Homologous structures have  
(A) similar origin & dissimilar function                      (B) dissimilar origin

but similar function

(C) structurally as well as functionally similar (D) normally non-functional

7. Analogous organs are those which are

(A) structurally similar (B) functionally similar  
(C) structurally as well as functionally similar (D) normally non-functional

8. The idea of "Survival of fittest" was given by

(A) Darwin (B) Herbert Spencer (C) Lamarck (D) Devries

9. Evolution is the best defined by

(A) inheritance of acquired characters (B) descent by modifications  
(C) spontaneous generation (D) struggle for existence

10. Which one is not a vestigial organ in man ?

(A) Vermiform appendix (B) Plica seminalis (C) Ear muscles (D) Epiglottis

11. Who wrote the "Origin of Species" ?

(A) G.J. Mendel (B) Lamarck (C) De-Vries (D) Charles Darwin

12. When an organ is used it will develop and if it is not used, it weakens to become vestigial. Who could have said this theory ?

(A) Darwin (B) De-Vries (C) Lamarck (D) Mendel

13. Fossils are

(A) fovea in the retina of vertebrate eye (B) remains of organisms present in the rocks

(C) the fossa present in the bones                      (D) foramens through which nerves pass

**14.** An experiment to prove that organic compounds were the basis of life, was performed by

- (A) Oparin                      (B) Miller                      (C) Melvin                      (D) Fox

**15.** Connecting link between Reptiles and Birds is

(A) dimetrodon                      (B) dodo                      (C) archaeopteryx                      (D) sphenodon

**16.** According to the Neo-Darwinian theory which of the following is responsible for the origin of new species?

(A) Mutations                      (B) Useful variations  
(C) Mutations together with natural selection                      (D) Hybridization.

**17.** Fossils are dated now by

(A) stratigraphic position                      (B) amount of calcium residue  
(C) association with other animals                      (D) radioactive carbon contents

**18.** Nucleoprotein gave most probably the first sign of

- (A) life                      (B) amino acid                      (C) soil                      (D) sugar

**19.** According to one of the most accepted theory the earth atmosphere before any life has originated consisted of water vapour, hydrogen, NH<sub>3</sub> and

(A) methane                      (B) nitrogen                      (C) oxygen                      (D) carbondioxide

20. Origin of life is due to  
(A) spontaneous generation                      (B) God's will  
(C) effect of sun rays on mud                      (D) chemical evolution
- 

## **SUBJECTIVE QUESTIONS**

### **SHORT ANSWER TYPE QUESTIONS**

1. What are the different ways in which individuals with a particular trait may increase in a population ?
2. Why are traits acquired during the life-time of an individual not inherited ?
3. Why are the small numbers of surviving tigers are cause of worry from the point of view of genetics ?

### **LONG ANSWER TYPE QUESTIONS**

4. Explain how sexual reproduction gives rise to more viable variations than asexual reproduction ? How does this affect the evolution of those organisms that reproduce sexually ?
5. How is the equal genetic contribution of male and female parents ensured in the progeny ?
6. Only variations that confer an advantage to an individual organism will survive in a population. Do you agree with this statement ? Why or why not ?

**ANSWERS**

## DAILY PRACTICE PROBLEMS # 16

<b>Que.</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>	<b>9</b>	<b>10</b>
<b>Ans.</b>	<b>A</b>	<b>B</b>	<b>D</b>	<b>C</b>	<b>B</b>	<b>A</b>	<b>B</b>	<b>A</b>	<b>B</b>	<b>D</b>
<b>Que.</b>	<b>11</b>	<b>12</b>	<b>13</b>	<b>14</b>	<b>15</b>	<b>16</b>	<b>17</b>	<b>18</b>	<b>19</b>	<b>20</b>
<b>Ans.</b>	<b>D</b>	<b>C</b>	<b>B</b>	<b>B</b>	<b>C</b>	<b>C</b>	<b>D</b>	<b>A</b>	<b>A</b>	<b>D</b>