



**MATRIX**  
**OLYMPIAD**

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# BIOLOGY

**Class - X**



**MATRIX**

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## *Few words for the Readers*

Dear Reader,

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The above thought has been our guiding principle while designing and collating the study material for **Matrix Olympiad** . And hence, we hope that this particular material will be helpful towards your preparation for **Matrix Olympiad**.

Our team at **MATRIX** has put in their best efforts for making this particular module interesting and relevant for you. Additional efforts have been made to ensure that the content is easy to understand and error free to the extent possible. However, there might remain some inadvertent errors in answer keys and theoretical portion and we would welcome your valuable feedback regarding the same.

If there are any suggestions for corrections, please write to us at [smd@matrixacademy.co.in](mailto:smd@matrixacademy.co.in) and we would be highly grateful.

Finally, we would like to end this message by a famous quote by Ernest Hemingway - *"There is no friend as loyal as a book."* So, please give your study material the time and attention it deserves, and it will surely help you reach newer heights in your fight with competition examinations.

With love and best wishes !

Team MATRIX

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# HOW DO ORGANISMS REPRODUCE

1

## **Concepts**

### ***Introduction***

- 1. *Importance of Reproduction***
- 2. *types of reproduction***
- 3. *Sexual reproduction in flowering plants***
- 4. *pollination***
- 5. *Fertilization***
- 6. *reproduction in humans***
  - 6.1 *Male reproductive system***
  - 6.2 *Female reproductive system***
  - 6.3 *Fertilization in humans***
  - 6.4 *Reproductive Health***

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### ***Exercise – I (Competitive Exam Pattern)***

### ***Exercise – II (Board Pattern Type)***

### ***Answer Key***





## INTRODUCTION

Reproduction is a process by which living organisms produce new individuals of their own kind and maintain their existence generation after generation. Reproduction is not essential to maintain the life of an organism but it is essential to maintain life on earth and perpetuation of species from one generation to another. Reproduction at its basic level (cellular reproduction) is involved in making similar or dissimilar body designs through the genetic material (DNA) present in the chromosomes of its nucleus.

DNA is the source of information for making proteins. Any change in the information leads to production of different proteins, which ultimately lead to altered body designs. Basic event in reproduction is production of DNA copies in a reproducing cell. The process is called DNA replication. When the cell divides into two, each new cell gets a copy of each DNA or chromosome along with the whole cellular apparatus.

Complete accuracy in DNA copying leads to two exactly identical cells but any error in duplication can lead to dissimilar cells or variations. The inbuilt tendency for variations during reproduction forms the basis for evolution. Variations during reproduction enable the population of a species to get adapted easily to a particular inhabiting place/niche. Hence, reproduction is linked to the stability of populations of species. Stronger variations are useful for the survival of species over time and enable the organisms to tide over any drastic alterations in their habitats.

## 1. IMPORTANCE OF REPRODUCTION

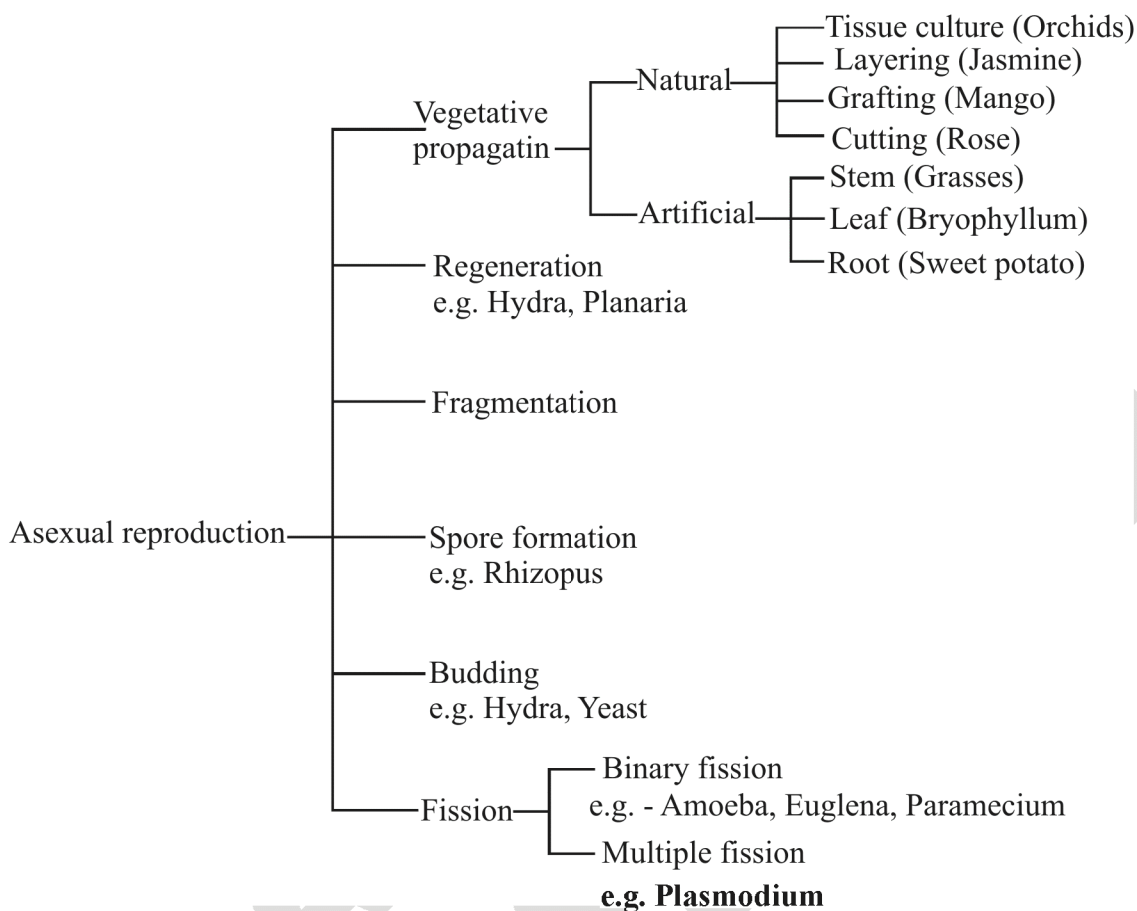
- (i) **Maintenance of the existence :-** Organisms are maintaining their existence on the earth since their origin, million years ago only because of reproduction.
- (ii) **Preservation of species :-** Species are preserved because of reproduction. It is possible because reproducing organisms produce new individuals which are very similar to themselves.
- (iii) **Role in evolution :-** Some variations are produced in the new organisms during reproduction which play an important role in evolution.

## 2. TYPES OF REPRODUCTION

There are two main methods of reproduction in living organisms.

### (A) ASEXUAL REPRODUCTION

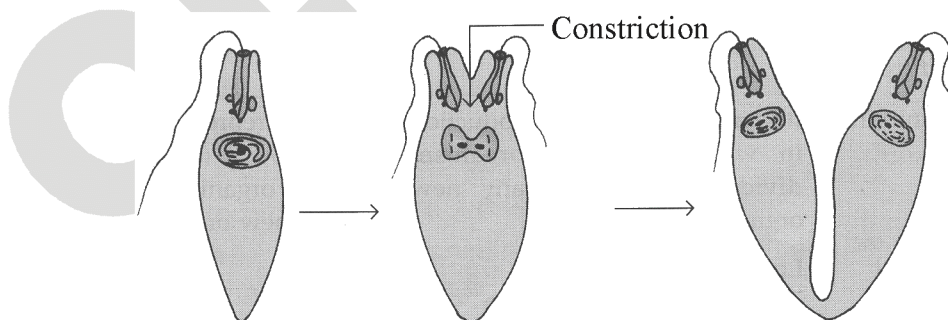
Production of offsprings by a single parent without the formation and fusion of gametes is called **asexual reproduction**. It is a primitive type of reproduction in which **offspring** is produced by a cell or any vegetative organ of an organism. In this type of reproduction **offsprings** are genetically identical to their parents.



**Modes of asexual reproduction** are fission, budding, spore formation, fragmentation, regeneration and vegetative propagation.

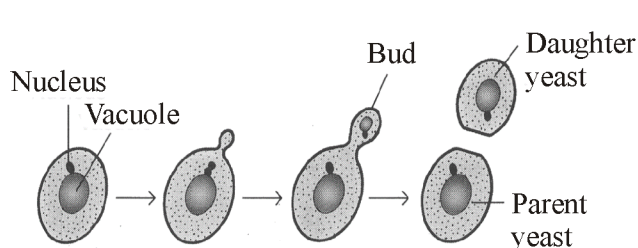
(i) **Fission** : It is a kind of asexual reproduction in unicellular organisms to create two new individuals. It can be of two types :

(a) **Binary fission**. One cell splits into two equal halves, e.g., many bacteria and protozoa like Amoeba, Euglena, Paramecium and Leishmania.

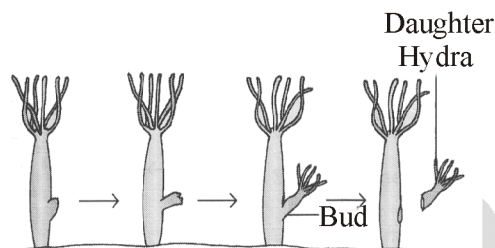


*Figure : Binary fission in Euglena*

- (b) **Multiple fission.** One cell divides into many daughter cells simultaneously, e.g., Plasmodium (malarial parasite), Amoeba in unfavourable conditions.
- (ii) **Budding :** Process in which an outgrowth (bud) is formed on the body of parent organism which then detaches and become a new organism. e.g. Yeast and Hydra.

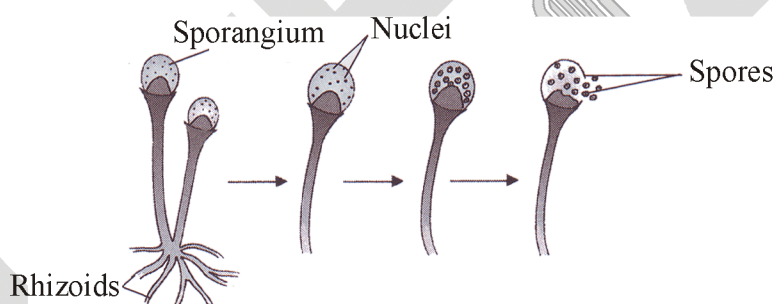


*Figure : Budding in Yeast*



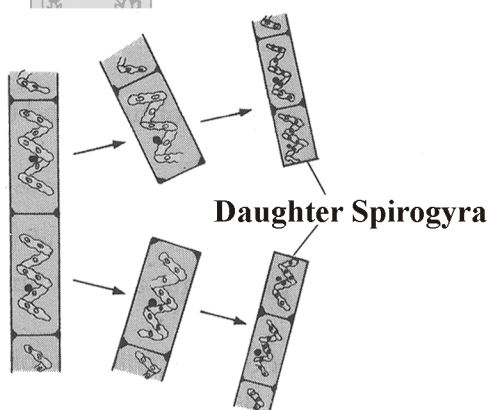
*Figure : Budding in Hydra*

- (iii) **Spore formation :** Spores are the microscopic asexual reproductive bodies with a thick wall. Spores are formed in '**sporangium**'. Each spore on germination give rise to a new organism e.g. Rhizopus, Penicillium.



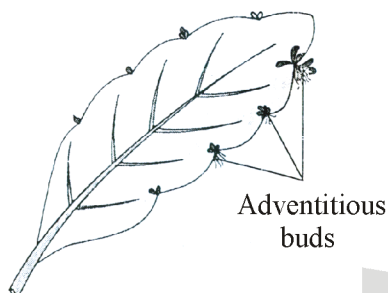
*Figure : Formation in Rhizopus*

- (iv) **Fragmentation :** In this process an organism breaks up into two or more fragments and each fragment develops into an adult organism e.g. Spirogyra.



*Figure : Spirogyra*

- (v) **Regeneration** : The process of getting back a full organism from the body parts of the parent is called **regeneration**. Regeneration is carried out by specialised cells. **e.g.** Hydra, Planaria.
- (vi) **Vegetative propagation** : This is an asexual method of reproduction in plants where vegetative parts namely root, stem and leaves give rise to new plants.



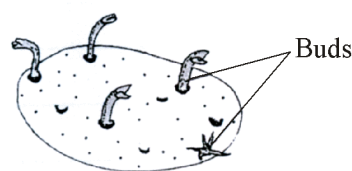
*Figure : Natural vegetative propagation by leaf (Bryophyllum)*

(a) **Natural vegetative propagation :**

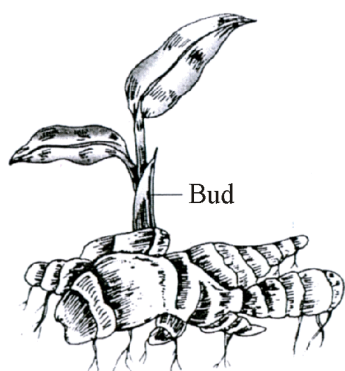
- **By leaves** : Leaves of some plants produce adventitious buds on their margin. These buds develop into new plants e.g. Bryophyllum, Kalanchoe.
- **By stem** : In many plant, underground stems produce aerial shoots annually under favourable conditions e.g. Potato, Zinger, Onion, Grass.



(a) Grass



(b) Potato



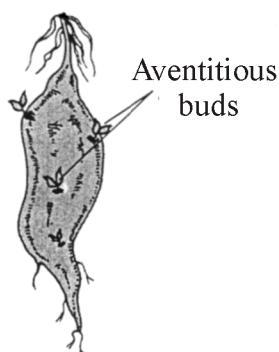
(c) Ginger



(d) Onion

*Figure : Natural vegetative propagation by stems.*

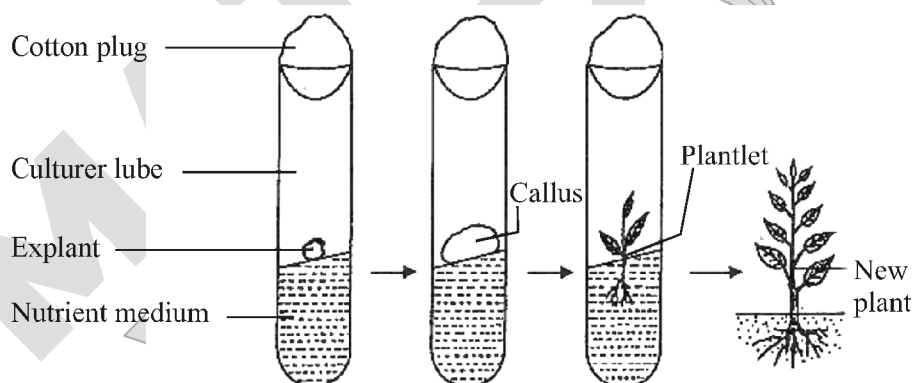
- **By roots :** Roots produce adventitious buds which develops into new plants. e.g sweet potato.



*Figure : Cutting*

- (b) **Tissue culture or micropropagation :** Cells or tissue which is isolated from the growing tip of plant called **explant**. The explant develops into undifferentiated mass of cells called **callus** in the proper culture medium. The callus is transferred to another medium containing hormones for growth and differentiation, that forms **plantlet**.

- The plantlets are transplanted into pot or soil to form mature plant.
- This technique is known as micropropagation. e.g. Orchids, Chrysanthemum.



*Figure : Artificial vegetative propagation by tissue culture*

### ADVANTAGES OF VEGETATIVE PROPAGATION

- It is a rapid, cheap and easy method of reproduction for the multiplication of plants.
- Disease free plants can be produced.
- Superior quality fruits or flowers can be produced by grafting.
- Genetically identical plants are produced.
- Plants raised by vegetative propagation can bear flowers and fruits earlier than those produce from seeds.



## Focus Point

- Grafting is not possible in monocot plants. Cambium activity is essential for the union of stock and scion.
- Tissue culture is also called micro-propagation because a large number of plants are formed from a small tissue.
- Virus free plants are produced by micropropagation.

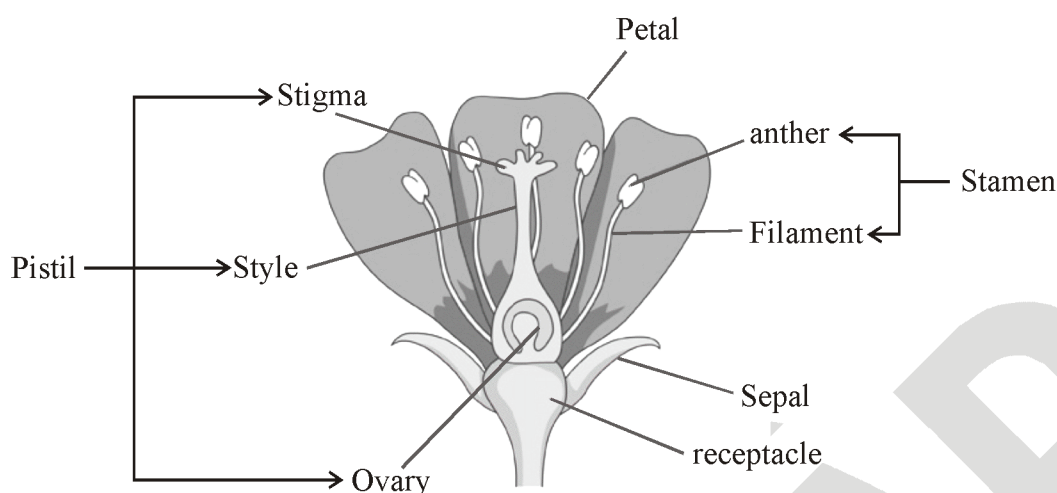
### (B) SEXUAL REPRODUCTION

It is a type of reproduction in which two different sexes (male and female) are involved. It involves the fusion of gametes from two different parents and results in the formation of new organism, which is genetically different from the parent.

S. No.	Features	Asexual reproduction	Sexual reproduction
1.	Number of parents	One	Two
2.	Resemblance with parents	Organisms produced resemble exactly with the parent.	Organisms do not resemble exactly with the parent but resemble in certain features with both the parents.
3.	Type of cell divisions	Amitotic/ mitotic.	Mitotic and meiotic both are present.
4.	Time duration	Takes less time.	Takes more time.
5.	Variations	Variations are absent.	Variations are present.
6.	Adaptability	Organisms produced have less adaptability	Organisms produced have more adaptability.
7.	Examples	Amoeba, Euglena, Plasmodium, Yeast.	Human beings, higher plants.



### 3. SEXUAL REPRODUCTION IN FLOWERING PLANTS



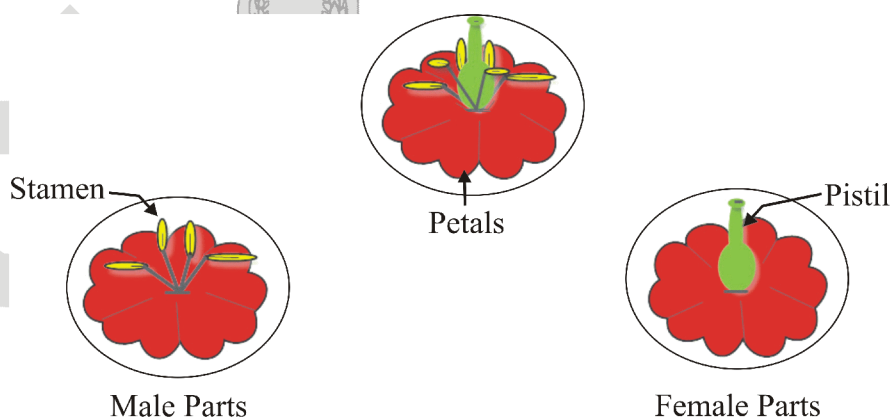
**Figure : Parts of flower**

Sexual reproduction takes place through the agency of flowers in angiosperms (flowering plants). Flower is a specialized condensed reproductive shoot of flowering plants on which the essential reproductive parts are inserted.

A typical flower has four whorls arranged on the **thalamus**.

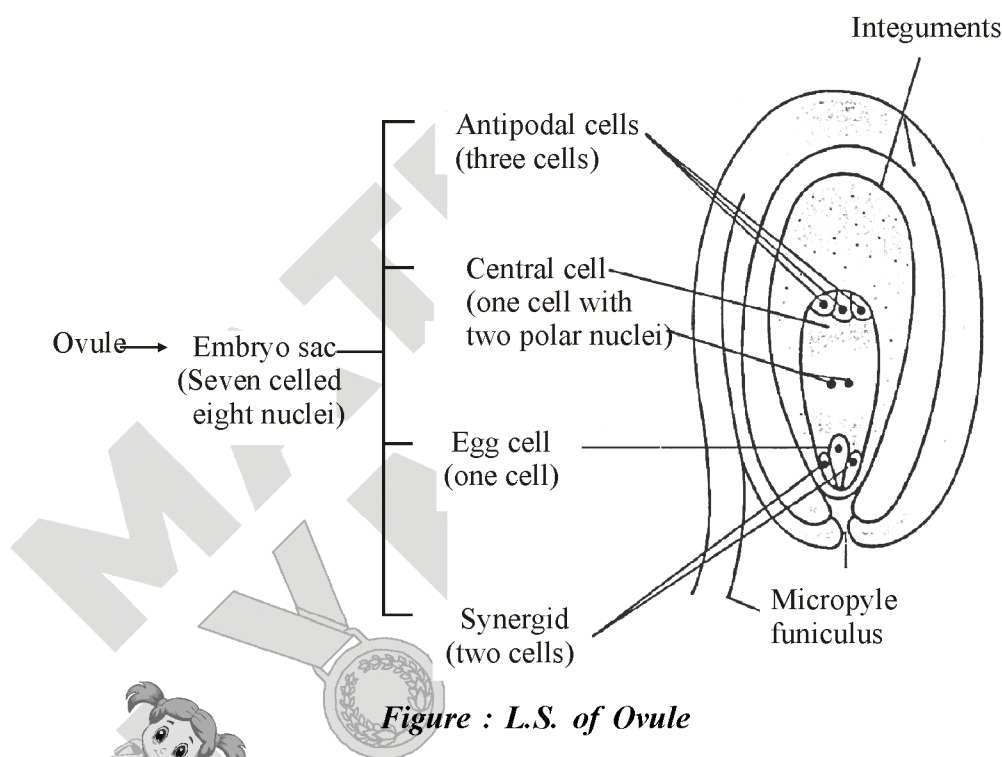
- Calyx
  - Corolla
  - Androecium
  - Gynoecium
- } Non essential whorls
- } Essential whorls

- (i) **Calyx** : It is the outermost whorl consisting of **sepals**. Sepals are green and leaf like structure. Calyx protect the flower bud before it opens.



**Figure : Flower parts**

- (ii) **Corolla** : It is the second whorl, inner to calyx, consisting of **petals**. Petals are generally large, coloured and showy. Corolla attract insects for pollination.
- (iii) **Androecium** : It is the third whorl, inner to corolla, consisting of male reproductive parts called **stamens**. Each stamen has two parts – Filament and anther. Anther is lobed structure present at the tip of filament. Each anther has pollen sacs (microsporangia) which contain pollen grains (microspores). Each pollen grain produces two male gametes/ male germ cells.
- (iv) **Gynoecium** : It is the fourth and innermost whorl consisting of **carpels**. Carpel is present in the centre of flower. Each carpel has three parts – Ovary, Style and Stigma. Ovary is a swollen basal part of carpel. It contains ovules which are attached to placenta. Each ovule contain an embryo sac that bears a haploid egg (female gamete). Style is the middle part of the carpel. It has stigma above it and ovary below it. Stigma is the apical part of carpel. It receives pollen grains.



**Figure : L.S. of Ovule**



## BUILD THE CONCEPT

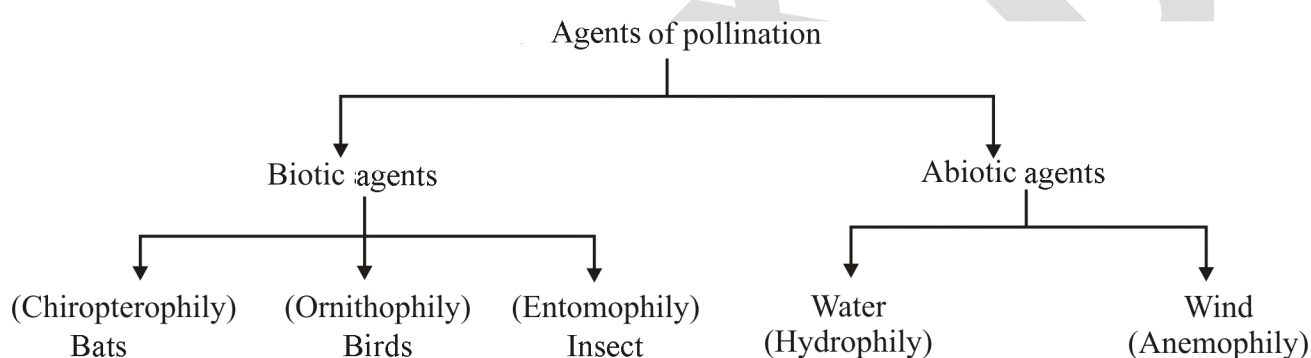
- **Perianth** :- If both sepals and petals are coloured and can not be distinguished from each other, then their whorl is known as **perianth**.
  - Calyx and corolla are non essential parts of the flower because they are not directly involved in reproduction.
  - **Bisexual flower** :- When the male and female reproductive parts are present in the same flower then it is called bisexual flower e.g. Hibiscus, Mustard.
- Unisexual flower** :- When the male and female reproductive parts are present in different flowers. e.g. : Papaya, Date palm, Mulberry, Gourd, Water melon.



## 4. POLLINATION

Process in which pollen grains are transferred from the ripe anther to the stigma. It is of two types :

- (i) **Self pollination :-** It is the transfer of pollen grains from an anther to the stigma of the same plant. If it is in the same flower it is called **autogamy** (e.g. Pea) and if it is between flowers of the same plant then it is called **geitonogamy** (e.g. Oxalis).
- (ii) **Cross pollination :-** It is the transfer of pollen grains from anther to the stigma of different plants of the same species (e.g. Mango).
- (iii) **Agents of pollination :-** Transfer of pollen from one flower to another is achieved by agents like wind, water, animals, insects and birds.



### Focus Point

- **Significance of bright colour of flower :-** The bright colour of flowers is meant to attract insects which help in pollination. White colour shine in dark which attracts insects at night. Similarly, bright colour day-blooming flowers attract insects.

## 5. FERTILIZATION

- Fertilization is the process of fusion of the male and female gametes, which takes place in the embryo sac present in the ovule.
- After pollination, pollen grains germinate on the stigma by producing pollen tube.
- The nucleus in the pollen tube divides into two male gametes.
- Pollen tube penetrates the stigma and passes through the style and enters the ovule through micropyle.
- It releases two male gametes in embryo sac.
- One male gamete fuses with egg cell and second male gamete fuses with the two polar nuclei.

- One male gamete + Egg cell  $\xrightarrow{\text{Syngamy}}$  Zygote.
  - Second male gamete + Two polar nuclei  $\xrightarrow{\text{Triple fusion}}$  Triploid nucleus (Primary Endosperm Nucleus)
- Syngamy + Triple fusion = Double fertilization.

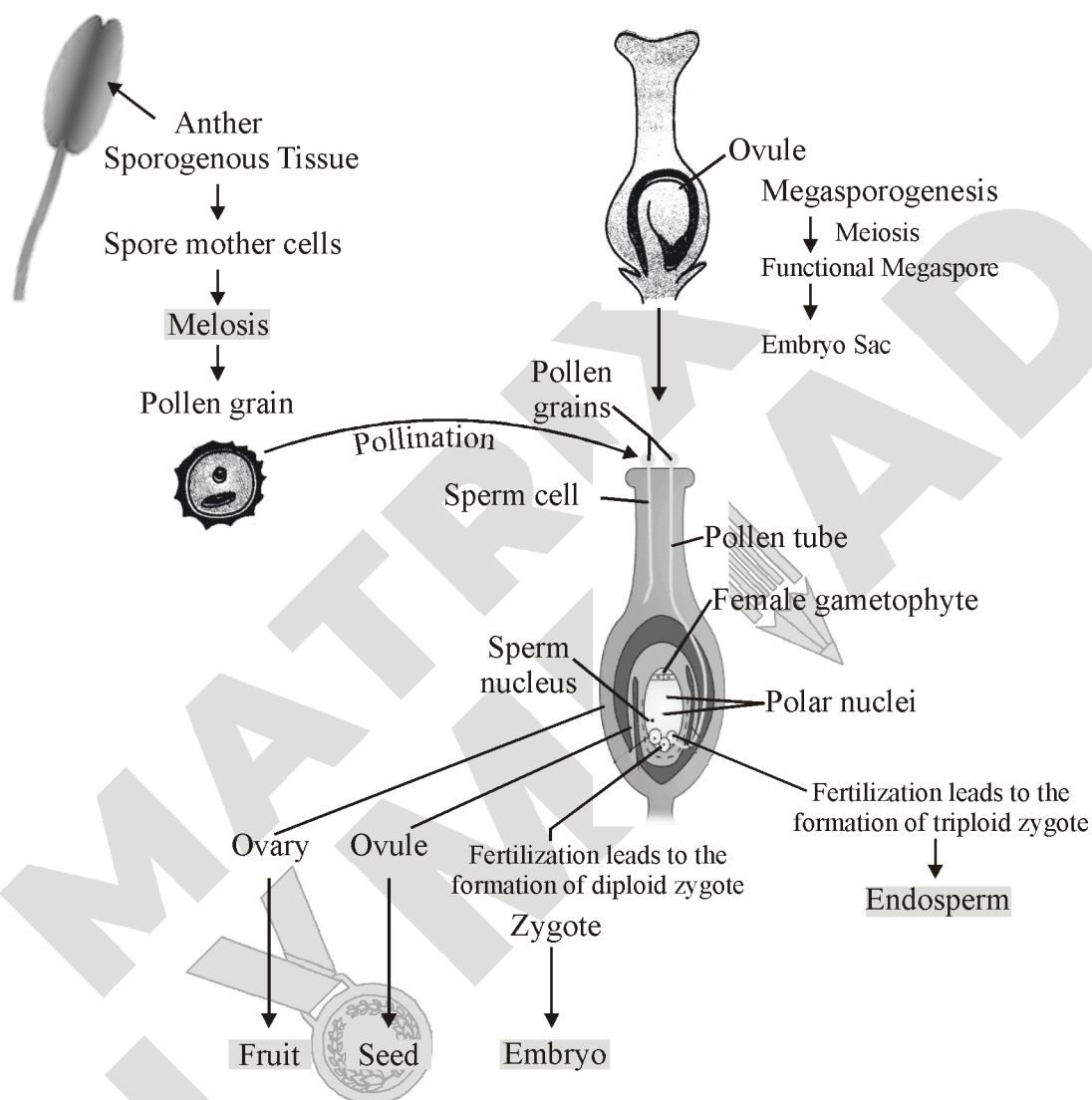
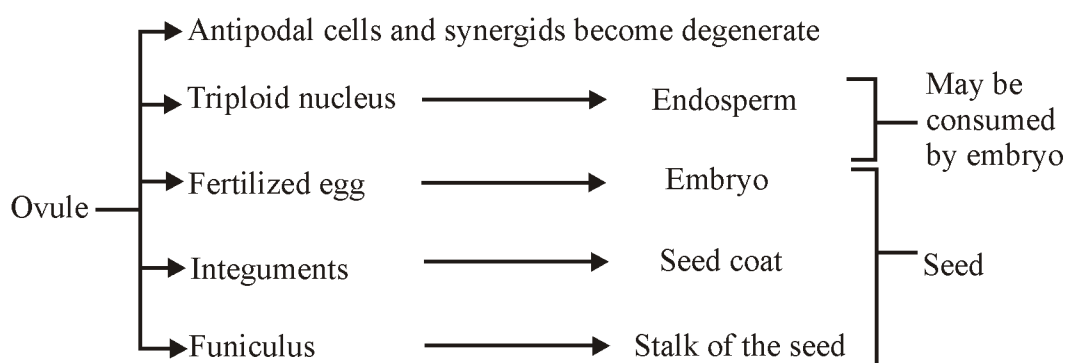


Figure : Fertilization

### POST FERTILIZATION CHANGES IN THE FLOWER

- Sepals, petals and stamen withers off.
- Style and stigma degenerates.
- Ovary develops into fruit.
- Ovule grows into seed.
- The seed contains the future plant or embryo which develops into a seedling under appropriate conditions.



## Focus Point

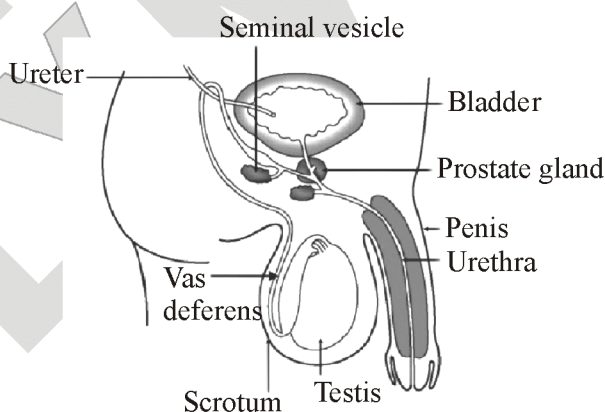
- **Endospermic seed** : If endosperm is not consumed.
- **Non endospermic seed** :- Endosperm may be consumed.

## 6. REPRODUCTION IN HUMANS

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

### 6.1 MALE REPRODUCTIVE SYSTEM

- The human male reproductive system consists of the following organs



*Figure : Reproductive system of a human male*

#### (i) Testes

- A pair of testes lies in a small sac-like muscular structure outside the abdominal cavity called scrotum. The function of testes is to produce sperm and male sex hormone called testosterone. The scrotum provides the optimal temperature for formation of sperms.

(ii) **Duct System**

- Testis is connected to epididymis through a fine tubule called as vasa efferentia. They help in conduction of sperms. Epididymis is a coiled tube-like structure firmly attached to the testis and serves as the storehouse of sperms. Inside the epididymis, sperms become mature and develop motility.
- Sperms are carried by a long tube called vas deferens or sperm duct into organs called seminal vesicles, where the sperms get nourished and stored.
- Ejaculatory duct enters into prostate gland and joins urethra to form common urino-genital duct.

(iii) **Accessory glands**

- **Prostate gland** : This secretes calcium, enzymes, hormones, citric acid.
- **Seminal vesicles** : These secrete fructose.
- **Cowper's glands** : These secrete an alkaline fluid.

(iv) **Copulatory Organ**

- Penis is a copulatory organ at the tip of which urinogenital duct opens. It also passes urine.

**Semen** : sperm + secretion of accessory glands.

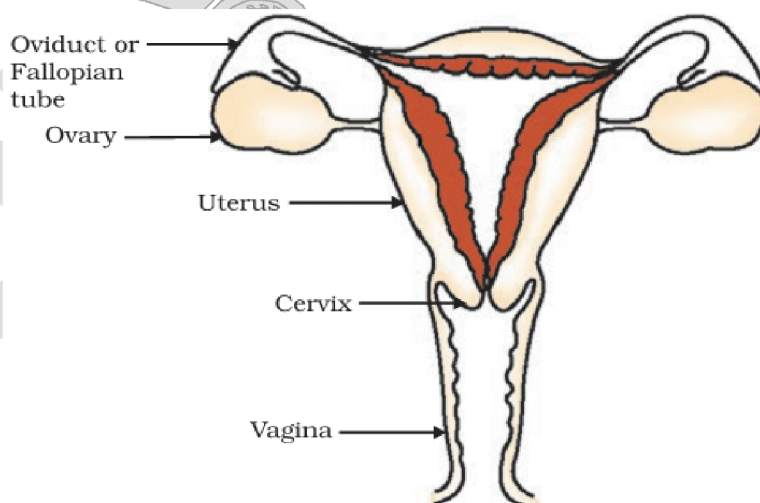
- Semen has chemicals for nourishment of sperms neutralizing the acidity of urethra and vagina, stimulating their movement in female tract

**Spermatogenesis** : This process of formation of sperm from spermatogonia is called as spermatogenesis.

- Testes lie outside the abdominal cavity as the process of spermatogenesis requires lesser temperature than the body temperature.

## 6.2 FEMALE REPRODUCTIVE SYSTEM

The human female reproductive system consists of the following organs :



*Figure : Reproductive system of a human*

- (i) **Ovaries** : Ovaries are a pair of small and oval-shaped organs, located in the abdominal cavity near the kidney. Ovaries are the female primary reproductive organs which perform dual functions of production of female gamete or ovum and the secretion of female sex hormones, estrogen and progesterone.
- (ii) **Fallopian tube or oviduct** : are a pair of long convoluted tubes that carry ovum or eggs from the ovary to the uterus. The fallopian tube has a funnel-shaped opening near the ovary. It is about 10 cms long muscular tube. It has 4 regions.
  - **Infundibulum** : It is broad, funnel shaped proximal part of fallopian tube. Its margin bears finger like processes called as fimbriae. This is meant to carry ovum by ciliary movement to the uterus.
  - **Ampulla** : It is a long, wide part of the fallopian tube next to the infundibulum.
  - **Isthmus** : It is the narrow part that follows ampulla.
  - **Uterine part**: It is also narrow and passes through the uterine wall.
- (iii) **Uterus or womb** : is a hollow, pear-shaped organ in which the embryo develops. Its upper portion is broader, while its lower portion is narrower, called cervix. Its inner lining is called endometrium. Middle is myometrium and outermost is perimetrium.
- (iv) **Vagina** : The cervix opens into the vagina which is a tubular structure and also called birth canal. Vagina receives sperms from the male and also serves as the passage through which the fully developed foetus is born.

**Hormones secreted by ovaries are** : Progesterone during pregnancy. Relaxin at the end of pregnancy. Oestrogen is secreted by graffian follicle. Its secretion is maximum during ovulation. It is also secreted during pregnancy. Oogenesis is a process of formation of ovum. The ovum is a rounded, non-motile cell.

### 6.3 FERTILIZATION IN HUMANS

- It includes release of ovum from the ovary, where it remains viable for 12-24 hours.
- Only one sperm is required for fertilization of the ovum.
- The head of the sperm penetrates ovum.
- This process is facilitated by acrosome and proteolytic enzymes.
- After penetration only head enter inside the ovum.
- Here the pronuclei of sperm and ovum fuse to form a new resultant nucleus each contributing 23 chromosomes, so that the resultant structure have 46 chromosomes.
- Fusion of male and female gametes is called as fertilization. This occurs at ampulla-isthmus junction.
- Zygote starts developing in fallopian tube and forms embryo, this later on moves to uterus.
- It gets attached to uterine wall 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 foetus 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.

## 6.4 REPRODUCTIVE HEALTH

Reproductive health is the state of physical, mental and social fitness to lead a responsible safe and satisfying reproductive life.

**Its knowledge provides-**

- Awareness to both male and female regarding fertility regulating methods.
- Birth control and better family planning.
- Prevention from sexually transmitted disease (STD).
- Early diagnoses and treatment of genetic disorders.

**Contraceptive-**

- Prevention of pregnancy is called contraception.
- Techniques used in preventing the occurrence of pregnancy are called contraceptive devices.
- Nowadays following contraception methods are in use :

### (i) Natural methods of contraception-

- **Rhythm method** : It is based on a fixed formula taking into consideration the timing of ovulation and the resulting likelihood of pregnancy on particular days of the menstrual cycle.
- **Lactational amenorrhea method** : It is used by a woman who is exclusively on breastfeeding and will not get her menstrual period till sixth month of childbirth.
- **Withdrawal method** : It is based on the removal of penis before insemination,
- **Abstinence method** : It refers to not having sex simply avoiding vaginal intercourse.

### (ii) Barrier methods of contraception : The following barrier methods are used for contraception :

- **Condom** : It is tubular latex sheath which is worn over the male copulatory organ or penis during sex.
- **Cervical cap** : It is rubber nipple that is fitted over the cervix.



- **Diaphragm** : It is tubular rubber sheath with flexible metal or spring ring at the margin which is fitted inside vagina.
- (iii) **Intra uterine contraceptive devices (IUCD or IUD) :**
- They are devices made of plastic, metal or a combination of the two which is inserted into uterus to prevent pregnancy generally through excessive secretion of cervical mucus.
  - The most common type is copper-T for preventing implantation.
  - It is functional for 3-5 years.
- (iv) **Chemical methods of contraception** : The following chemical methods are used for contraception :
- **Oral pills** : They contain progesterone with or without estrogen. E.g. Saheli, Contron etc.
  - **Morning-after pills** : They prevent contraception even after coitus. E.g. i-pill.
  - **Creams** : jellies and foaming tablets (vaginal pills) which are placed in vagina for killing the sperms at the time of coitus.
- (v) **Surgical methods** : It is of two types, vasectomy in males and tubectomy in females.
- **Vasectomy** : The two vasa deferentia of the male are blocked by cutting a small piece and tying the rest. This prevents passage of sperms from testes to penis.
  - **Tubectomy** : A portion of both the fallopian tubes is excised or ligated to block the passage of ovum.
- Sexually transmitted diseases (STD)** : These diseases are transmitted through unsafe sexual act. e.g. :
- Gonorrhoea caused by *Neisseria gonorrhoea* (bacteria).
  - Syphilis caused by *Treponema pallidum* (bacteria).
  - AIDS (Acquired Immuno deficiency Syndrome) caused by human immuno deficiency virus (HIV).



### Focus Point

- If a woman uses a Copper-T as method of contraception for avoiding unwanted pregnancies, then Copper- T cannot protect her from acquiring sexually transmitted diseases (if her partner has such a disease).
- **Norplant** : Hormonal implant used for birth control. It is effective for up to 5 years. These are hormone carrying rods about the size of matchsticks inserted under the skin normally in the upper arm.

## EXERCISE – I

### ONLY ONE CORRECT TYPE

1. Binary fission occurs in -  
(A) Amoeba (B) Paramecium  
(C) Leishmania (D) All the above
2. Multiple fission occurs in -  
(A) Plasmodium (B) Paramecium  
(C) Bacteria (D) Euglena
3. Bryophyllum can multiply vegetatively by -  
(A) Leaves (B) Aerial stems  
(C) Underground stems (D) Roots
4. Sugarcane is multiplied by -  
(A) Seeds (B) Root cuttings  
(C) Stem cuttings (D) Leaves
5. Potato is grown from -  
(A) Cutting of aerial stems  
(B) Cutting of tubers having depressions  
(C) Cuttings of tubers without depressions  
(D) Cuttings of roots
6. The grafted portion of a plant is called -  
(A) Stalk (B) Stock  
(C) Layer (D) Scion
7. Grafting is most successful in -  
(A) Dicots (B) Monocots  
(C) Pteridophytes (D) Bryophytes
8. Jasmine is multiplied vegetatively through -  
(A) Stem cutting (B) Leaves  
(C) Root cutting (D) Layering
9. Yeast multiplies by -  
(A) Binary fission (B) Budding  
(C) Multiple fission (D) All the above
10. Spirogyra multiplies by -  
(A) Budding (B) Regeneration  
(C) Fragmentation (D) Both A and B
11. Hydra cut into a number of pieces will -  
(A) Die  
(B) Sporulate  
(C) Develop sex organs  
(D) Regenerate to form new individuals
12. Budding is a method of asexual reproduction in -  
(A) Planaria (B) Hydra  
(C) Rhizopus (D) Amoeba
13. In flower the male organ is -  
(A) Stamen (B) Carpel  
(C) Sepal (D) Petal
14. Receptive part of carpel is -  
(A) Placenta (B) Ovary  
(C) Stigma (D) Style
15. On germination each pollen grain produces -  
(A) One male gamete  
(B) Two male gametes  
(C) Three male gametes  
(D) Four male gametes
16. Fertilization in flowering plants produces -  
(A) Embryo (B) Endosperm  
(C) Nucellus (D) Both A and B
17. Seed is formed from -  
(A) Unfertilised ovary (B) Fertilised ovary  
(C) Fertilised ovule (D) Unfertilised ovule
18. Which is shed in a fertilized flower ?  
(A) Stamens (B) Petals  
(C) Style and stigma (D) All the above



19. Gonads form -  
 (A) Sex organs (B) Gametes  
 (C) Sex hormones (D) Both B and C

20. Mucosal lining of uterus is -  
 (A) Mesometrium (B) Endometrium  
 (C) Epimetrium (D) Epidermis

21. Ovum is fertilized in -  
 (A) Vagina (B) Uterus  
 (C) Fallopain tube (D) Ovary

22. Gestation period in human is -  
 (A) 270 days (B) 290 days  
 (C) 200 days (D) 245 days

23. Which one is a mechanical barrier to conception ?  
 (A) Oral pill (B) Norplant  
 (C) Abortion (D) Condom

24. An IUCD device is -  
 (A) Copper T (B) Condom  
 (C) Cervical cap (D) Vasectomy

### MATCH THE COLUMN TYPE

25. **Column I** **Column II**
- |             |              |
|-------------|--------------|
| (P) Calyx   | (1) Ovary    |
| (Q) Corolla | (2) Sepal    |
| (R) Stamen  | (3) Stigma   |
| (S) Carpel  | (4) Petal    |
|             | (5) Anther   |
|             | (6) Filament |
- (A) P → 2, Q → 4 R → 5, 6, S → 1, 3  
 (A) P → 1, Q → 2 R → 3, 5, S → 4, 6  
 (A) P → 3, Q → 1 R → 2, 5, S → 4, 6  
 (A) P → 2, Q → 5 R → 4, 6, S → 1, 3

*Space for Notes :*

**VERY SHORT ANSWER TYPE**

1. What is multiple fission ?
2. Define fragmentation ?
3. What is regeneration ?
4. Define budding ?
5. Define layering ?
6. Define grafting ?
7. What is sexual reproduction ?
8. What are gametes ?
9. Define fertilization.
10. What are essential floral organs ?

**SHORT ANSWER TYPE**

1. Write a note on human fallopian tubes.
2. Differentiate between menarche and menopause
3. Distinguish vasectomy from tubectomy.
4. What is significance of sexual reproduction ?
5. Differentiate self pollination and cross pollination?
6. Distinguish pollination from fertilization.
7. Describe multiple fission.
8. Describe budding in yeast.
9. Describe budding in Hydra.
10. Differentiate between fission and budding.

**LONG ANSWER TYPE**

1. Describe male reproductive system of humans.
2. Describe menstrual cycle.
3. Describe the various methods of contraception.
4. Describe the structure of a flower

5. Write a note on pollination in flowering plants.
6. Describe the process of fertilization in flowering plants.
7. Describe the methods of asexual reproduction in multicellular organisms.
8. Describe the natural methods of vegetative reproduction. Write down its importance.

**TRUE / FALSE TYPE**

1. In asexual reproductions, clones are formed.
2. Stoppage of menstruation permanently is called Menarche.
3. Anthers is a trilobed structure.
4. Bird Pollination is also called as ornithophily.
5. In human males , there is the common passage for both urine and sperms.

**FILL IN THE BLANKS**

1. In Rhizopus asexual reproduction takes place by ..... formation.
2. In Bryophyllum vegetative propagation takes place through their .....
3. The process in which new organisms are formed by existing organism is called .....
4. In Spirogyra, asexual reproduction, takes place by .....
5. Natural vegetative propagation takes place in sweet potato by .....

### Answer Key

#### EXERCISE-I

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
D	A	A	C	B	D	A	D	B	C	D	B	A	C	B
16	17	18	19	20	21	22	23	24	25					
D	C	D	D	B	C	A	D	A	A					

#### EXERCISE – II

##### TRUE/FALSE TYPE

1. T      2. F      3. F      4. T      5. T

##### FILL IN THE BLANKS

1. Spore      2. Leaf      3. Reproduction      4. Fragmentation      5. Root

## SELF PROGRESS ASSESSMENT FRAMEWORK

(CHAPTER : HOW DO ORGANISMS REPRODUCE)

CONTENT	STATUS	DATE OF COMPLETION	SELF SIGNATURE
Theory			
In- Text Examples			
NCERT Exercises			
Exercise I			
Exercise II			
Short Note-1			
Revision - 1			
Revision - 2			
Revision - 3			
Remark			

### NOTES :

1. In the status, put “completed” only when you have thoroughly worked through this particular section.
2. Always remember to put down the date of completion correctly. It will help you in future at the time of revision.



*Space for Notes :*

A series of horizontal dotted lines providing space for notes.



# LIFE PROCESS & NEUTRITION

2

## Concepts

### *Introduction*

#### **1. *Anabolic pathways or biosynthetic pathways***

##### **1.1 *Catabolic pathways***

#### **2. *Nutrition***

##### **2.1 *Modes of nutrition***

☛ *Autotrophic nutrition*

☛ *Heterotrophic nutrition*

##### **2.2 *Types of heterotrophic nutrition***

##### **2.3 *Nutrition in unicellular organisms (Example – Amoeba)***

#### **3. *Digestive System of Human***

##### **3.1 *Alimentary canal***

##### **3.2 *Digestive glands***

##### **3.3 *Physiology of nutrition***

#### **4. *Nutrition in plants***

##### **4.1 *Photosynthesis***

##### **4.2 *Site of Photosynthesis***

##### **4.3 *Mechanism of photosynthesis***

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### *Exercise – I (Competitive Exam Pattern)*

### *Exercise – II (Board Pattern Type)*

### *Answer Key*



## INTRODUCTION

All the living organisms including human beings perform a number of activities such as nutrition, respiration, excretion, growth and reproduction. These activities are characteristics of living organisms, and through such activities they maintain their lives. These maintenance function of living organisms are known as **life processes**.

Chemical reactions which take place within cells or organisms during various vital activities are called **biochemical reactions**.

**Metabolism** is a word used to describe the sum total of all the chemical and physical changes that are constantly taking place in living matter and are necessary for life. The word **metabolite** refers to a substance which undergoes various changes during metabolism. For example, carbon dioxide and water are metabolites used in the process of photosynthesis.

The metabolic pathways are of two types :

### 1. ANABOLIC PATHWAYS OR BIOSYNTHETIC PATHWAYS

**Anabolic pathways** or **biosynthetic pathways** in which biosynthesis of organic compounds occurs, or in other words, complex substances are synthesized from simpler ones ; for example photosynthesis.

#### 1.1 CATABOLIC PATHWAYS

**Catabolic pathways** in which the breakdown of complex organic substances into simpler ones occurs (as in respiration)

In anabolic pathways or processes of **anabolism** energy is used (**endothermic reactions**), while in catabolic pathways or **catabolism**, energy is released (**exothermic reactions**).

**Following Criteria to define if something is alive :-**

- (a) **Nutrition** :- The processes by which the organisms obtain and utilise the nutrients (food).
- (b) **Respiration** :- The process that involves breakdown of respiratory substrates through oxidation and release of usable energy.
- (c) **Transport** :- The process in which the substances absorbed or synthesized in one part of the body are carried to other parts of the body.
- (d) **Excretion** :- The process involved in removal of the excess or toxic wastes from the body.
- (e) **Control and coordination** :- The process which helps the living organisms to receive information from the surroundings and behave accordingly in order to survive in the changing environment around them.
- (f) **Cellular organisation** :- Body of all living organisms is made of cells. It is defining character of alive.
- (g) **Movement and Locomotion**
- (h) **Consciousness** :- All organisms from prokaryotes to eukaryotes can sense and respond to environmental factors.

## 2. NUTRITION

Nutrients are inorganic as well as organic substances which the organisms obtain from their surroundings in order to synthesize their body constituents and use them as a source of energy.

The process of intake of nutrients and its utilization by an organism in various biological activities.

OR

A process to transfer a source of energy from outside the body of the organism (food), to the inside is called nutrition.



### Focus Point

There are various types of nutrients on the basis of function they perform :-

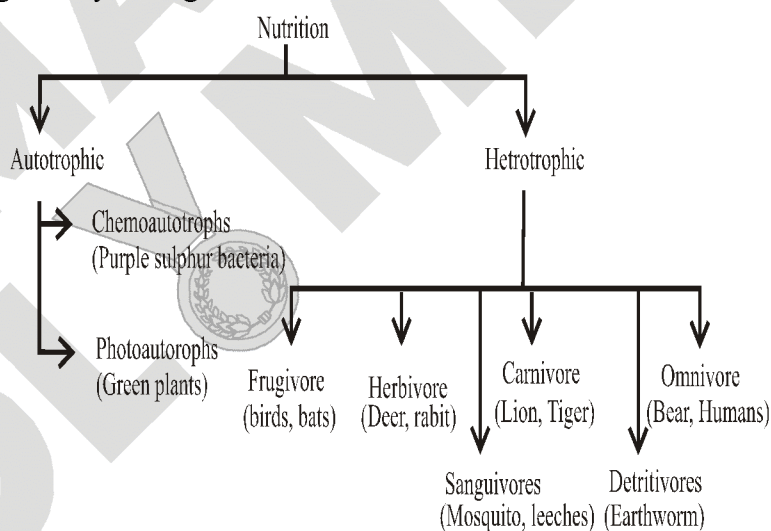
**e.g. Energy foods :- Carbohydrates and fats.**

**Body building foods :- Proteins and mineral salts.**

**Regulating foods :- Vitamins and minerals.**

### 2.1 MODES OF NUTRITION

Method of obtaining food by the organism is called mode of nutrition



#### Autotrophic nutrition

The mode of nutrition in which the organisms prepare (or synthesize) their own organic food by using inorganic raw material ( $\text{CO}_2$  &  $\text{H}_2\text{O}$ ). They are also called **autotrophs**.

**e.g.** Plants, Photosynthetic and chemosynthetic bacteria and cyanobacteria etc.



## Heterotrophic nutrition

The mode of nutrition in which the organisms derive their nutrition from other organisms. They take ready made organic food from other dead or living plants or animals. The living organisms showing heterotrophic nutrition, are called **heterotrophs**.

**e.g.** All animals, fungi, many bacteria and some non-green plants (insectivorous plants) and man.

## 2.2 TYPES OF HETEROTROPHIC NUTRITION

Depending upon the mode of obtaining food, the heterotrophic nutrition is of following types :

### (a) Holozoic nutrition (Holo-Complete + Zoon-animal)

The mode of nutrition in which all animals take in complex solid food material is called holozoic nutrition.

**It contains following steps :-**

- **Ingestion** :- Taking in complex organic food through mouth opening.
- **Digestion** :- Change of complex food into simple diffusible form by the action of enzymes.
- **Absorption** :- Passing of simple, soluble nutrients into blood or lymph.
- **Assimilation** :- Utilization of absorbed food for various metabolic processes.
- **Egestion** :- Expelling out the undigested food.

**e.g.** All animals including vertebrates and Invertebrates.



## Focus Point

☆ Depending upon the **type of the food habit**, animals are divided into three categories :-

**(i) Herbivores** :- Animals that depend up on green plants are known as herbivores.

**e.g.** Goat, Cow, Deer, Rabbit.

**(ii) Carnivores** :- Animals which eat flesh of other animals as food are called as carnivores.

**e.g.** Lion, Tiger.

**(iii) Omnivores** :- Animals which eat both plants and animals as food are known as omnivores.

**e.g.** Rat, Pigs, Crows, Cockroaches and Humans.

**(b) Saprotrophic (Sapro - Rotten ; Trophos - Feeder) Nutrition** :- In this type of nutrition the organisms obtain their food from decaying organic substances. Organisms are also called **saprotrophs**.

**e.g.** Bacteria, Fungi.

**(c) Parasitic nutrition (para-other) :-**

The mode of nutrition in which one organism (called parasite) derive its food from other living organism (Host) is called parasitic nutrition. e.g. Tape worm, *Ascaris*, *Plasmodium*, Liver flukes, *Cuscuta* etc.

**DIFFERENCES BETWEEN AUTOTROPHIC & HETEROTROPHIC NUTRITION :-**

Characters	Autotrophic Nutrition	Heterotrophic nutrition
(1) Source of Energy	Sunlight or chemical energy	Readymade food
(2) Mode of Nutrition	Photosynthesis or Chemosynthesis plants or animals	Feeding upon dead or living
(3) Occurrence	Found in green plants, Blue-green algae, certain Bacteria	Found in Animals, fungi, Most of the bacteria

**DIFFERENCES BETWEEN HOLOZOIC AND SAPROTROPHIC NUTRITION :-**

Feature	Holozoic nutrition	Saprotrophic nutrition
1. Nature of food	Solid food (Whole plant or animal or their parts) is ingested	Liquid food (Dead and decaying organic matter) is ingested
2. Site of digestion	Inside the body	Outside the body as enzymes are released on the food material that convert solid food into simple soluble form
Examples	Most of the Animals	<b>Fungi</b> – Yeast



## Focus Point

Animals which depend upon the blood of other animals known as **sanguivores**.

**e.g.** Bedbug, Mosquito, Leech etc.

**Mutualistic nutrition** :– The mutualistic nutrition can be defined as the interdependent nutrition in which each organism is dependent mutually on the other.

**e.g.** The lichens share mutualistic nutrition between a fungus and a Algae.

### 2.3 NUTRITION IN UNICELLULAR ORGANISMS (EXAMPLE – AMOEBA)

**Food** – *Amoeba* is a holozoic and omnivorous animal. It feeds upon microscopic organisms like bacteria, Paramecium, Diatoms, Algae and dead organic matter.

**Mechanisms.** Nutrition in *Amoeba* involves the following steps:

**(i) Ingestion** :– *Amoeba* has no mouth, so ingestion may occur at any point of body surface but generally it occurs at the advancing end of the body. Ingestion occurs with the **help of pseudopodia**. The opening of food cup gradually becomes narrower and narrower, and finally closes. So the food is finally enveloped and taken inside a **food-vacuole** (called **phagosome**) along with a drop of water.

**(ii) Digestion** :– *Amoeba* shows **intracellular** and **vacuolar digestion**. In the cytoplasm, food vacuole fuses with lysosomes containing digestive enzymes. In this, the complex and non-diffusible nutrients are changed into simple and diffusible nutrients. Medium inside the food vacuole is **first acidic but later becomes alkaline**, (as in the alimentary canal of man).

**(iii) Absorption and assimilation** :– In absorption, the diffusible nutrients pass through vacuolar membrane into cytoplasm by diffusion and are then distributed to all the body parts by **streaming movements** of cytoplasm called **cyclosis**. Due to this, the size of food vacuole gradually decreases.

In the cytoplasm, a part of the absorbed food is oxidised to produce energy, most of simple nutrients are combined to synthesize complex compounds.

**(iv) Egestion** :– *Amoeba* has no anus, so egestion may occur at any point on the body surface.

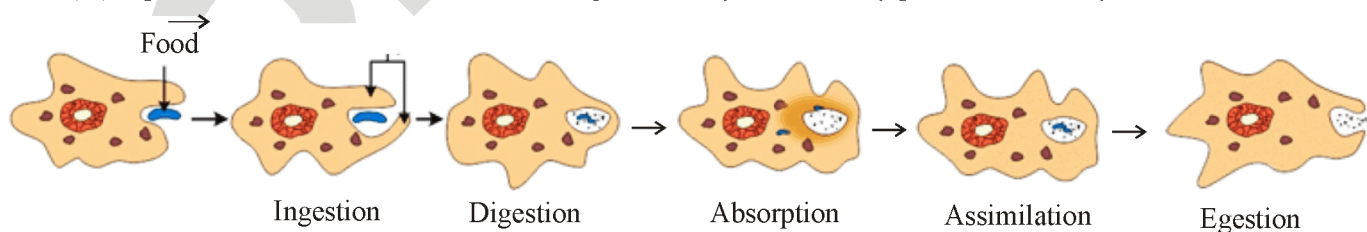


Figure : Digestion in *Amoeba*



## Focus Point

**(a) Food :-** The substance which is palatable, delicious enough and energy provider is called food.

Chemically food consists of six essential components :-

(i) Carbohydrates (ii) Fats (iii) Proteins (iv) Minerals (v) Vitamins (vi) Water

**(b) Intracellular and Extra-cellular Digestion :-**

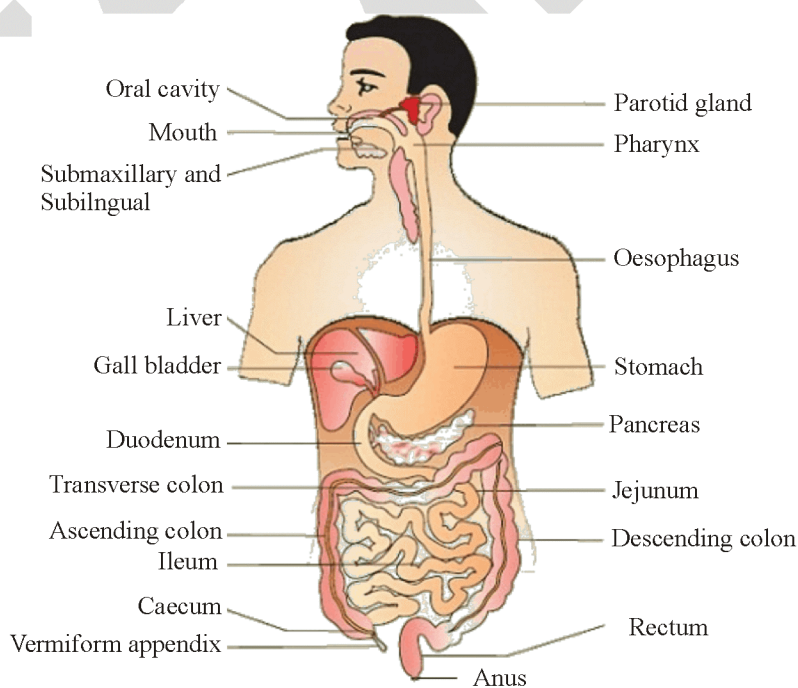
**Intracellular Digestion :** This type of digestion occurs inside the cell cytoplasm. The food inside the cell occurs as food vacuole. The digestive enzyme in this case are secreted inside the cell. They digest the contents of the food vacuole. So the entire process of digestion occurs inside the cell. e.g. Protozoans [*Amoeba*], Sponges

**Extracellular Digestion :-** Extra cellular digestion is a process in which saprobionts feed by secreting enzymes through the cell Membrane onto the food. The enzyme catalyze the digestion of the food into molecules small enough to be taken up by diffusion, transport and phagocytosis.

eg. Hydra and sea anemone.

### 3. DIGESTIVE SYSTEM OF HUMAN

Human digestive system consists of the alimentary canal and digestive glands and it involves mastication, swallowing, digestion of food and elimination of undigested matter.



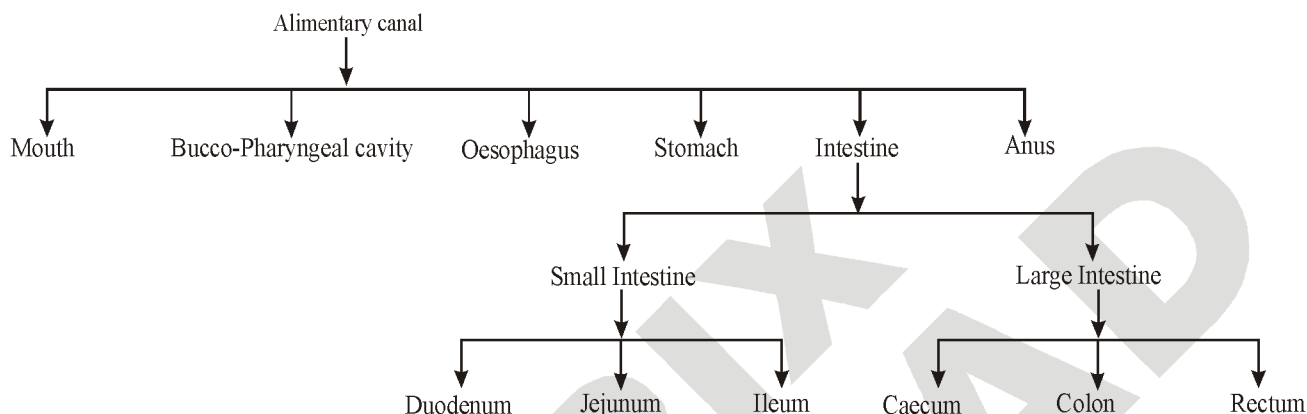
**Figure : Digestive system of human**

It consists two parts :-

### 3.1 ALIMENTARY CANAL

The alimentary canal is basically a long tube extending from the mouth to the anus.

It is differentiated into following parts.



#### MOUTH

It is a transverse slit bounded by movable lips. The lips serve to close and open mouth, holding the food in between and also help in speaking.

#### BUCCOPHARYNGEAL CAVITY / MOUTH CAVITY

Mouth leads into the **mouth cavity** or **oral** or **buccal cavity**. The roof of mouth cavity is formed by palates i.e., **hard** and **soft palate**, the floor by **tongue** and the sides by the **cheeks**. The other conspicuous structures are the **teeth** and **salivary glands**.

**(a) Tongue** :- The floor of the mouth cavity is occupied by muscular, large, mobile tongue. It remains attached on its under surface to the floor by fold of mucous membrane called the **lingual frenum**. The tongue is covered with mucous membrane and its upper surface is raised into **lingual papillae** which contain microscopic taste buds.

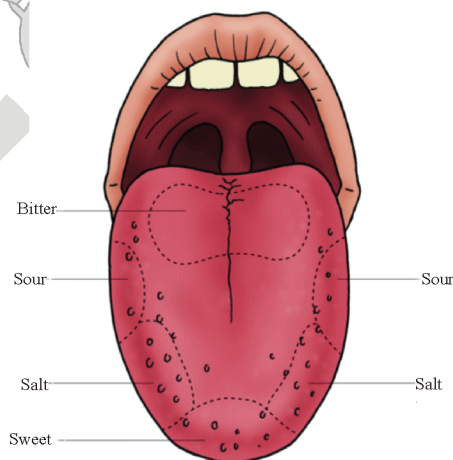


Figure : Tongue

### Functions of tongue :-

- It acts like a spoon during ingestion of food.
- It brings food under teeth for mastication
- It moves food in buccal cavity for mixing of saliva.
- It helps in swallowing food.
- It cleans teeth by removing small food particles from their surface.
- It helps in speaking.
- It is the main organ of taste.
- It keeps the mouth moist by the secretion of both mucus and serous or water like fluid.
- In dogs during panting it helps in thermoregulation by quick evaporation of water of saliva.
- In some mammals tongue is used to clean skin by licking.

**(b) Teeth :-** Thecodont (Teeth present in bony socket), Heterodont (Teeth are of four types) and diphyodont (Teeth that come two time in life). Teeth are present in human body.

### Teeth are of following types :

- (i) Incisors** – Biting the food.
- (ii) Canines** – Wearing and tearing of food.
- (iii) Premolars** – Crushing and grinding the food.
- (iv) Molars** – Crushing and grinding the food.

### Dental Formula

(i) Milk teeth/ Primary

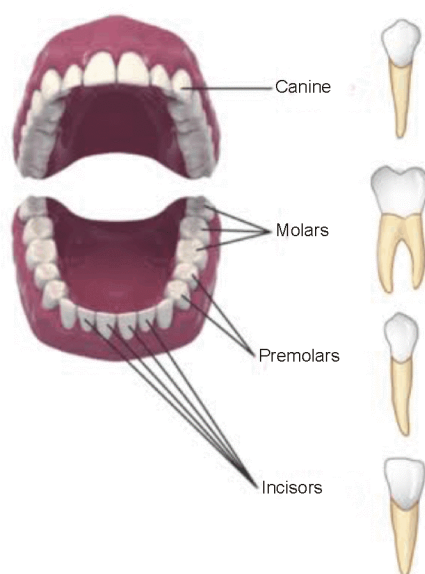
(ii) Permanent teeth

$$\frac{\text{No. of teeth in half part of upper jaw}}{\text{No. of teeth in half part of lower jaw}} \times 2 = x$$

• In child  $\rightarrow I \frac{2}{2}, C \frac{1}{1}, Pm \frac{0}{0}, M \frac{2}{2} = \frac{5}{5} \times 2 = \text{Total 20 teeth}$

• In Man  $\rightarrow I \frac{2}{2}, C \frac{1}{1}, Pm \frac{2}{2}, M \frac{3}{3} = \frac{8}{8} \times 2 = \text{Total 32 teeth}$





*Figure : Various types of permanent teeth of man*

## PHARYNX

The buccal cavity opens into a short narrow chamber called **pharynx or throat**. Pharynx is incompletely divided into three parts by soft palate – the nasopharynx dorsal to the soft palate, oropharynx below the soft palate and laryngopharynx into which both these parts communicate round the freely hanging uvula. The oropharynx and laryngopharynx are associated with swallowing. The laryngopharynx communicates with oesophagus through gullet and with larynx through glottis. The glottis is guarded by an elastic and muscular flap called epiglottis which closes glottis during swallowing to prevent food from entering into wind pipe. Thus pharynx serves two ways –

- (i) as a passage between nose and wind pipe (trachea)
- (ii) as food passage between mouth cavity and oesophagus. Resonance of voice also occurs due to pharynx.

## OESOPHAGUS (FOOD PIPE)

It conducts the food by **peristalsis** (Wave like movement).

The oesophagus is a 25-30 cm long, leading from the pharynx to stomach. It runs down the neck, behind trachea and through thorax, finally piercing the diaphragm to open into stomach. The upper 1/3rd part is composed of voluntary muscles and the lower 2/3rd of involuntary muscles. The muscular coat has a peristaltic action for driving the food towards the stomach. There are no digestive glands but only mucous glands in oesophagus.

## STOMACH

It is a thick, muscular and J-shaped sac present on the left side of upper part of abdomen. Beneath diaphragm lying to the left side of abdomen is J-shaped stomach. It is the widest part of alimentary canal, size and shape of which varies according to the contents and sex. It can be distinguished into three regions – Fundic part, Body part and Pyloric parts. The exit is guarded by a pyloric sphincter. The partly digested paste like food is forced into intestine through pyloric sphincter, due to peristaltic waves of stomach.

### Functions of Stomach :-

- Temporary storage of food.
- Partial digestion of food by gastric juice.
- Churning of food.
- The stomach regulates the flow of partially digested food into the small intestine.

### INTESTINE

It distinguished into two parts :-

(a) Small Intestine

(b) Large Intestine

**(a) Small intestine :-** It is a long (about 6 meter) narrow (average diameter 4 cm), tubular and coiled part. It is differentiated into anterior duodenum, middle jejunum and posterior ileum. It is mainly concerned with completion of digestion and absorption of food.

**(i) Duodenum :** This proximal part starts after pyloric end of stomach. It is about 25 cm long lying against the posterior abdominal wall. It is curved like 'C' or a horseshoe and ends behind the stomach. A common bile duct and a pancreatic duct opens in middle of 'C' of duodenum by a common aperture over a raised area called ampulla of Vater.

**(ii) Jejunum :** The Jejunum (a latin word meaning empty) is so called because it is always found empty after death.

**(iii) Ileum :** It is the last part of small intestine.

#### Small intestine designed to absorb digested food as :

- It is lengthy about 6 meters.
- Inner lining has two types of folds called villi and microvilli.
- Each villus has blood capillaries and a lymph capillary.

**(b) Large intestine :-** It is shorter (about 1.5 meter) and wider (Average diameter 6 cm) than small intestine. It is differentiated into caecum, colon and rectum. It is the site of absorption of water from digested food. It helps in formation and temporary storage of faeces.

### ANUS

It lies at the base of trunk and is for egestion.



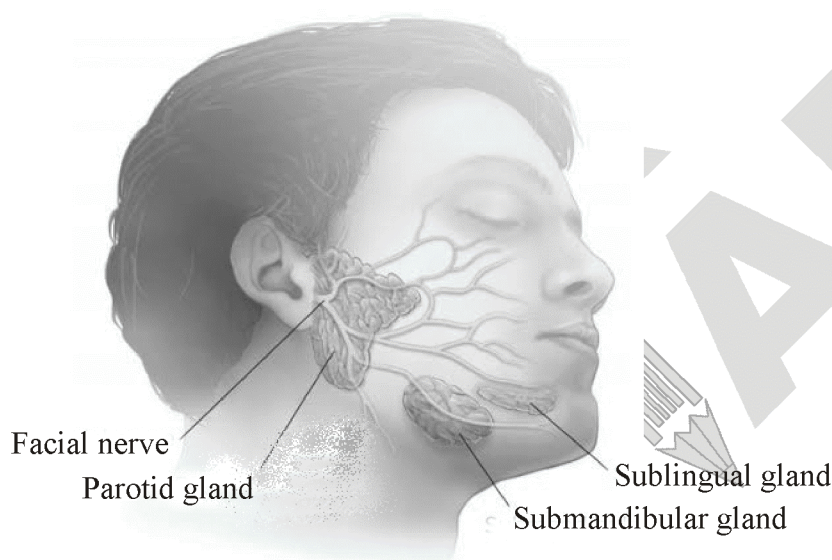
### 3.2 DIGESTIVE GLANDS

They secrete digestive juices which contain digestive enzymes. These are of following types.

#### SALIVARY GLANDS

In man, there are three pairs of salivary glands. These secrete saliva which contains a digestive enzyme called **ptyalin** or **Salivary amylase**.

- Parotid gland
- Submaxillary
- Sublingual glands



*Figure : Salivary glands*



#### Focus Point

- Saliva is an antiseptic as it kills germs and bacteria due to presence of an enzyme called **Lysozyme**. Saliva makes the food soft, slippery and helps in digestion of starch due to presence of salivary amylase enzyme.
- Our mouth starts **watering on eating** food of our interest. This water is basically the saliva secreted by the salivary gland which get activated on eating or seeing or thinking of a food.
- Involuntary contraction & relaxation movement is called **peristalsis**.

#### GASTRIC GLANDS

Gastric glands are present in the wall of stomach and secrete gastric juice.

#### LIVER

It is lobed and reddish-brown coloured largest gland of body present in the right side of upper part of the abdomen. It synthesizes and secretes bile juice. Gall bladder is present below the right lobe of liver. It stores and secretes bile.

## PANCREAS

It is a yellow- coloured heterocrine gland present just behind the stomach. It secretes pancreatic juice. Pancreatic duct carries pancreatic juice to small intestine.

It also secretes two hormones : Insulin and Glucagon.

## INTESTINAL GLANDS

These lie in the wall of small intestine and secrete intestinal juice (Succus entericus).

### 3.3 PHYSIOLOGY OF NUTRITION

#### INGESTION

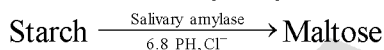
Man is **omnivorous** in feeding and is **holozoic**.

Ingestion involves carrying the food to the mouth with the help of hands and cutting of food with incisors or canines depending upon the nature of food.

#### DIGESTION

In man, digestion is started in **buccal cavity** and completed in **intestine**.

**(a) In buccal cavity :–** Here, food is chewed with the help of premolars and molars which increases the rate of action of **salivary amylase**. Food is mixed with saliva of salivary gland.



**(b) In stomach :–**

Food is mixed with gastric juice which contains mucus, hydrochloric acid, pepsin, rennin and a weak lipase enzyme.

Mucus, lubricates the food and protects the inner lining of the stomach from the action of acids.

#### Functions of Hydrochloric acid

- Stops the action of salivary amylase in stomach.
- Kills the bacteria present in the food.
- Activates pepsin.
- Provides acidic medium.

**Pepsin** hydrolyses proteins into proteoses and peptones.

**Lipase** enzymes hydrolyses small amounts of fats into fatty acids and glycerol.

Curdling of milk is done by the enzyme **rennin**. (Rennin is not found in human beings, it found only in cattles).

Digestion of proteins in man starts from stomach. In buccal cavity there is no digestion of proteins because saliva contains no proteolytic (protein digesting) enzyme.

**(c) In small intestine :–**

The small intestine is the site of the **complete digestion** of carbohydrates, proteins and fats.

Food is mixed with three **digestive juices**, bile juice, pancreatic juice and intestinal juice.

Bile juice provide **alkaline medium** and **emulsifies fats** [conversion of larger fat globules into smaller fat droplets] but is a non enzymatic digestive juice so has no chemical action on food.

Pancreatic juice contains **trypsin, pancreatic amylase and pancreatic lipase** enzymes which digest the peptones, starch and fats into peptides, maltose and fatty acids.

Intestinal juice contains **aminopeptidase, intestinal amylase, maltase, sucrase and lipase** enzymes:–

Peptides  $\xrightarrow{\text{Amino peptidase}}$  Amino acid

Maltose  $\xrightarrow{\text{Maltase}}$  Two glucose

Fats  $\xrightarrow{\text{Lipase}}$  Fatty acid + Glycerol

Lactose  $\xrightarrow{\text{Lactase}}$  Glucose + Galactose

Sucrose  $\xrightarrow{\text{Sucrase}}$  Glucose + Fructose

### ABSORPTION

Absorption of the digested food occurs through the epithelial surface of the villi & microvilli of small intestine.

- Inner surface of small intestine is raised into 4 millions of finger-like folds called **villi**.
- Each cell of villus is with electron microscopic processes called **microvilli**.
- Each villus is with blood capillaries and a lymph capillary.

### ASSIMILATION

It is a process by which absorbed nutrient are utilized to resynthesize complex molecules like carbohydrates, proteins and fats inside the cells.

### EGESTION

Removal of waste products from the body is known as **egestion**.



### Focus Point

**(a) Emulsification :-** Emulsification is the phenomenon of physically breaking of large sized fat globules into large number of fat droplets by the bile-salts of the bile juice. This increases the surface area for digestion of fats by the lipase enzyme.

**(b) Alimentary Canal :-** The digestive canal where the entire process of digestion is accomplished, called alimentary canal.

⇒ The alimentary canal of herbivores is longer than the alimentary canal of carnivores, because herbivores have to digest the cellulose, which is difficult to digest.

⇒ The herbivorous animals like cow which eat grass need a longer 'small intestine' to allow the cellulose present in grass to be digested completely.

⇒ The carnivorous animals like tigers which eat meat have a shorter small intestine.

**TABLE : DIGESTIVE GLANDS, THEIR SECRETIONS & ACTION**

Name of Gland	Secretion	Enzyme	Site action	Substrates	Products
Salivary Glands	Saliva	Salivary Amylase	Buccal cavity	Starch	Maltose, Isomaltose
Gastric glands	Gastric Juice	(a) Pepsin (Pepsinogen inactive)	Stomach	Protein	Peptones
		(b) Rennin (Prorennin inactive)	Stomach	Casein	Paracasein
Pancreas	Pancreatic Juice	(a) Pancreatic Amylase	Small intestine	Starch Glycogen	Maltose, Isomaltose
		(b) Trypsin (Trypsinogen inactive)	Small intestine	Proteins	Peptides
		(c) Chymotrypsin (Chymotrypsinogen inactive)	Small intestine	Casein (milk)	Paracasein
Intestinal gland (Crypts of Lieberkuhn)	Intestinal juice	(a) Enterokinase (Hormone)	Small intestine	Trypsinogen (inactive)	Trypsin (active)
		(b) Aminopeptidase	Small intestine	Peptides	Smaller peptides Amino acids
		(c) Dipeptidases	Small intestine	Dipeptides	Amino acids
		(d) Isomaltase	Small intestine	Isomaltose	2 Glucose
		(e) Maltase	Small intestine	Maltose	2 Glucose
		(f) Sucrase	Small intestine	Sucrose	Glucose, Fructose
		(g) Lactase	Small intestine	Lactose	Glucose, Galactose
		(h) Lipase	Small intestine	Triglycerides	Monoglycerides, Fatty acids
Liver	Bile (Bile + pigments)	No enzymes	Duodenum	Fats	Fat droplets

#### 4. NUTRITION IN PLANTS

Green plants are autotrophic. They synthesize their own food by the process of photosynthesis. Autotrophic plants are able to produce food so they are known as producers. -

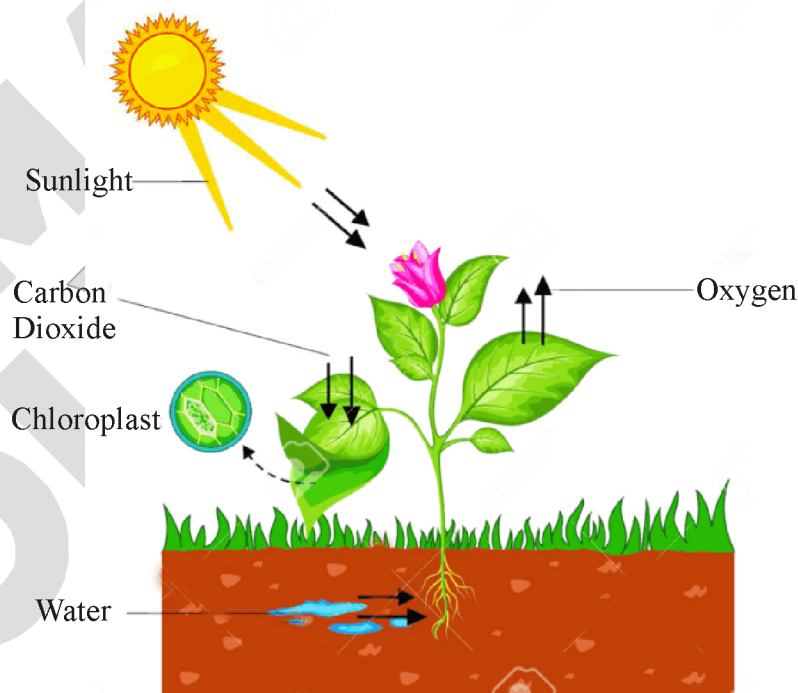


### Focus Point

First true and oxygenic photosynthesis starts in cyanobacteria (blue green algae). 90% of total photosynthesis is carried out by hydrophytes (mostly marine algae). "The process of absorption and conversion of light energy into chemical energy by green plants is called as photosynthesis". This chemical energy is stored in the form of adenosine triphosphate (ATP) and reduced nicotinamide adenine dinucleotide phosphate (NADPH<sub>2</sub>).

#### 4.1 PHOTOSYNTHESIS

Photosynthesis is a process by which green plants synthesize organic food (carbohydrate) from carbon dioxide and water using solar energy by chlorophyll pigments. The sugar produced is stored in the form of starch in plants.



*Figure : Photosynthesis*

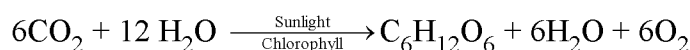


## IMPORTANCE OF PHOTOSYNTHESIS

Photosynthesis is an anabolic process in nature for providing food supply to the living organisms.

It purifies the atmospheric air, by consuming CO<sub>2</sub> and evolving oxygen.

**The over all equation of photosynthesis is :-**



**Requirements for photosynthesis :-**

⇒ **Sunlight**

⇒ **Photosynthetic pigment**

⇒ **Carbondioxide**

⇒ **water**

CO<sub>2</sub> and water work as raw materials which are obtained from the atmosphere and the soil respectively.

**(a) Sunlight :-** Sun is a natural source of light for photosynthesis. Sunlight is an electromagnetic spectrum.

Photosynthetic pigments absorb only visible/white light from electromagnetic spectrum.

White light (380 nm to 760 nm) is composed of wavelength of seven different colours violet, indigo, blue, green, yellow, orange and red (VIBGYOR).

**PAR** (Photosynthetically Active Radiation) : 400nm to 700nm.



### Focus Point

Types of chlorophyll :-

There are six different types of chlorophyll : Chl.-a, Chl.-b, Chl.-c, Chl.-d, Chl.-e and bacteriochlorophyll.

Beside chlorophyll certain other pigments are also present in plants like -

Carotenoid → Carotenes (orange colour) and xanthophylls (yellow colour).

Phycobilins : It is present in Blue- green algae and Red algae etc.

**(b) Photosynthetic pigment :-** These are chlorophylls carotenoids (carotenes and xanthophylls) and phycobilins.

These pigments absorb only visible light. Chl-a and b absorb only blue and red light and reflect green light.



### Focus Point

**Compensation point**

The intensity of light at which amount of CO<sub>2</sub> used during photosynthesis becomes equal to the amount of CO<sub>2</sub> released during respiration by plants is called as compensation point.

Compensation point occurs at low light intensity that is during morning and during evening hours. The structure of guard cells in monocots is dumb-bell shaped.

### (c) Carbondioxide :

All the plants need carbondioxide to form carbohydrates. The carbon dioxide is obtained by the plants from the atmospheric air. In the terrestrial plants, the  $\text{CO}_2$  enters into the cells of leaves through tiny pores called **stomata** which always remain present on the surface of leaves.

### STOMATA

These are tiny pores or microscopic aperture guarded by two kidney shaped or bean shaped guard cells.

### Functions :-

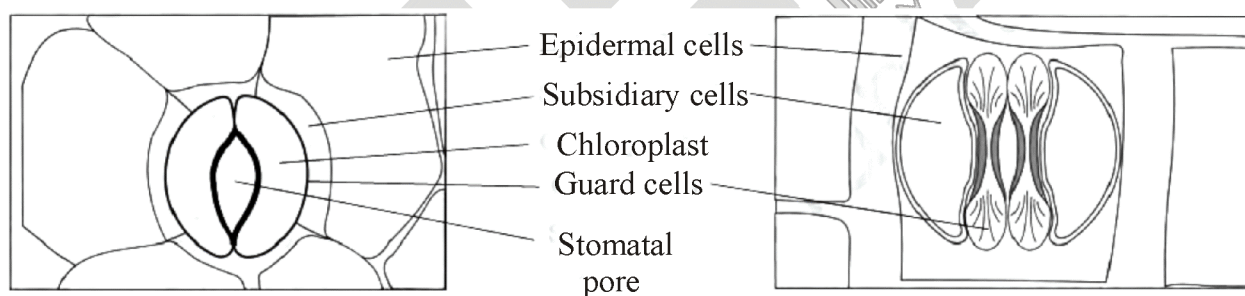
⇒ Massive amount of a gaseous exchange take place in the leaves through stomata.

Exchange of gases also occurs across the surface of stem, root and leaves.

⇒ Large amount of water is lost through stomata.

**Guard cells :-** These are kidney shaped cells which cover single stoma. They contain chloroplast also.

**Function :-** They regulate the opening and closing of the stoma and also perform photosynthesis.



*Figure : Open and Closed stomata*

### OPENING AND CLOSING OF STOMATA

When the guard cells swell due to the entry of water, the stomata gets opened. But when the guard cells shrink due to the loss of water, the stomata gets closed.



### Focus Point

Desert plants take up  $\text{CO}_2$  at night and prepare an intermediate which is acted upon by the energy absorbed by the chlorophyll during the day and form glucose.

In aquatic plants,  $\text{CO}_2$  is obtained from the water where it remains present in dissolved form. Such plants absorb carbondioxide in solution form, all over their surface from the surrounding water.



**(d) Water :** Water is always needed by the plants for its use during photosynthesis.

Inside the chloroplasts of the leaves, the water molecules split into hydrogen and oxygen with the help of light energy of solar light.

Some mineral salts like N, P, K, Fe, Mg required by the plants are also transported to different parts of the plant along with the water.

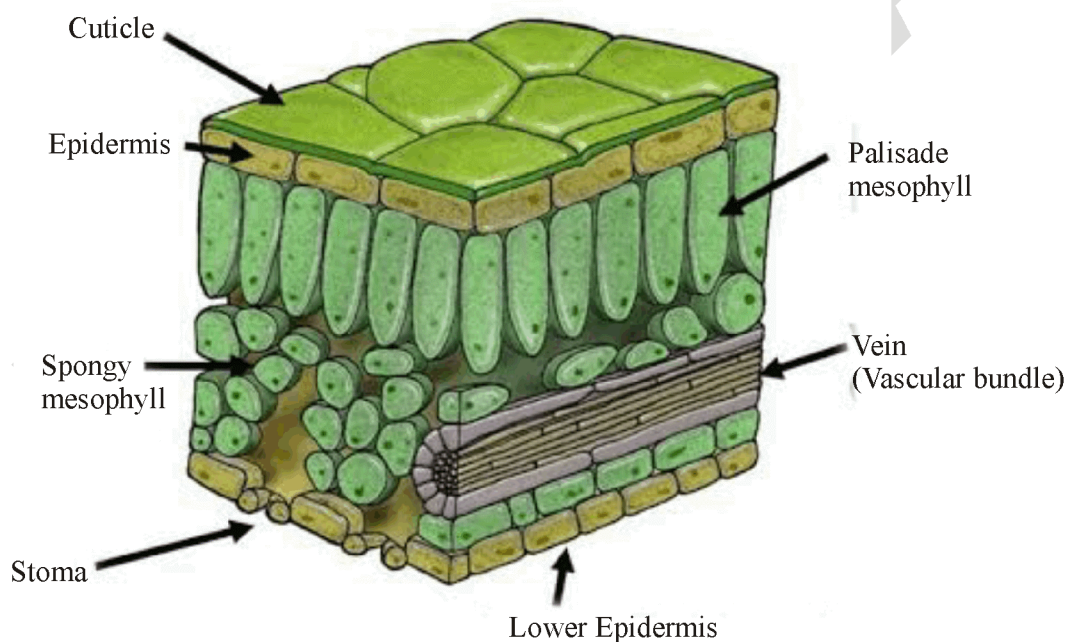
Nitrogen is an essential element used in the synthesis of proteins and other compounds (chlorophyll, DNA and RNA).

Nitrogen is taken up in the form of inorganic nitrates or nitrites which have been prepared by symbiotic bacteria from atmospheric  $N_2$ .

## 4.2 SITE OF PHOTOSYNTHESIS

Green plastid (Chloroplast or Kitchen of the cell).

When we observe the cross section of a leaf under microscope, we can see the mesophyll cells full of green dots. These green dots are chloroplasts containing chlorophylls.



*Figure : Cross section of leaf*

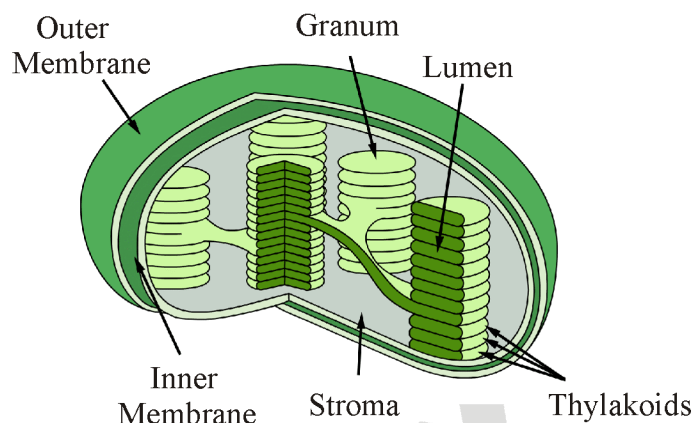
## CHLOROPLASTS

They are green coloured plastids. Their green colour is due to the presence of green pigments the chlorophylls. Each developed chloroplast has two distinct areas - grana and stroma.

⇒ **Grana (Singular-granum) :-** The light reaction of photosynthesis takes place in this part of chloroplast.

In a granum large number of lamellae remain arranged like a stack of coins. These lamellae are called as **thylakoids**, which contain chlorophyll pigments.

⇒ **Stroma** :– It forms the matrix of the chloroplast. The dark reactions of photosynthesis take place in stroma.



**Figure : Structure of Chloroplast**

### 4.3 MECHANISM OF PHOTOSYNTHESIS

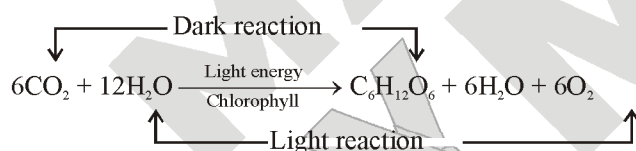
During photosynthesis following events occur :-

- (i) Absorption of light energy by chlorophyll.
- (ii) Conversion of light energy into chemical energy and splitting of water molecule into hydrogen & O<sub>2</sub>
- (iii) Reduction of CO<sub>2</sub> to carbohydrates.

All these events can be categorised into two main phases :-

(a) Light phase

(b) Dark phase

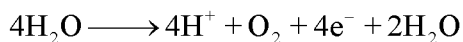


**(a) Light reaction :-**

- ◆ It is also called as photochemical process,
- ◆ It was discovered by → 'Robert Hill'. Therefore it is also called as Hill's reaction
- ◆ **Site** : Grana of chloroplast.
- ◆ **Raw materials** : Light and water.
- ◆ **Products** : ATP, NADPH<sub>2</sub> and O<sub>2</sub>
- ◆ **It consists of 3 steps :**

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

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



$O_2$  is liberated as by product and  $H^{+}$  ions are used for reduction of NADP.

**(iii) Photophosphorylation :** During this process ATP are produced. It takes place in quantasomes as inorganic phosphate is required to convert ADP into ATP.



### Focus Point

Light reaction was discovered by 'Robert Hill', therefore it is also called as Hill's reaction.

Light reaction is a photochemical process.

Photophosphorylation :-

The process of formation of ATP in the presence of sunlight is known as photophosphorylation.

Oxygen released during photosynthesis comes from water instead of  $CO_2$  as was earlier thought.

**(b) Dark reaction :-** In this step synthesis of carbohydrates from carbondioxide takes place. It is not light dependent hence it is called as dark reaction. This reaction occurs inside stroma of chloroplasts where light energy is not captured.

During this reaction, the chemical energy formed during light reaction ( $ATP$  and  $NADPH_2$ ) is utilised for the fixation and conversion of carbon dioxide into a simple carbohydrate, that is glucose.

The glucose molecules thus formed are further converted by the cellular machinery into various chemicals required by the plants.



### Focus Point

Dark reaction was discovered by Melvin Calvin and Benson therefore it is also called as Calvin Cycle.

Dark reaction is a thermochemical reaction.  $CO_2$ ,  $NADPH_2$ ,  $ATP$ ,  $RUBP$  and Rubisco enzymes all are required in Dark reaction.

$RUBP$  - Ribulose bi phosphate.

$RuBisCO$  - Ribulose Bi phosphate Carboxylase Oxygenase.

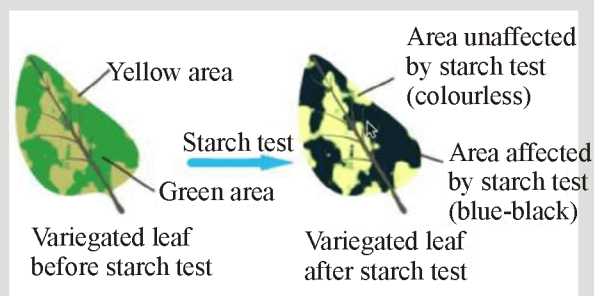
## LAB TIME

Let's Do & Learn



**To prove that chlorophyll is essential for photosynthesis.**

**Materials required :** Plant with variegated leaves, materials for starch test, test, i.e., iodine, solution. beaker, test tubes.



**Figure :** Activity to show that chlorophyll is essential for photosynthesis

### Procedure :

- (i) A potted plant with variegated leaf (Coleus, Croton) is kept in darkness for two days to make the leaves starch free.
- (ii) A leaf is removed from the plant and tested with iodine for starch, after decolourising if first with water and then with alcohol.

### Conclusion :

It is seen that the portion of the leaf which is devoid of chlorophyll remains colourless (starch-free) whereas the rest of the leaf turns blue-black due to the presence of starch.

### Difference between light and dark reactions.

S.No.	Features	Light reaction	Dark reaction
1	Requirement of light	Required	Not required
2	Takes place inside	Thylakoid membranes of the chloroplast	The stroma region of chloroplast
3	ATP and NADPH <sub>2</sub>	ATP and NADPH <sub>2</sub> are produced by the conversion of light energy into chemical energy	ATP and NADPH <sub>2</sub> formed during light reaction are used for the fixation of CO <sub>2</sub> into carbohydrate
4	Sugar formation	No sugar formation takes place	Sugar formation takes place
5	Release of oxygen	Oxygen is released	No oxygen is released

**Factors affecting photosynthesis :–**

(a) Light

(b) Water

(c) Temperature

(d) CO<sub>2</sub>

(e) Oxygen

### (a) Light

The source of light for planet earth is sun, although some marine algae also utilise the light of moon.

Out of the total solar energy, only 2% solar energy is used in photosynthesis.

The quality and intensity of light also affects photosynthesis.

**Quality** – Red and blue lights are most effective in photosynthesis. But the rate of photosynthesis is maximum in red light.

There is no photosynthesis in presence of green light because green parts of plants reflect whole of the green light.

**Intensity** – The increase in intensity of light increases photosynthesis.

Intensity of sunlight  $\propto$  Rate of photosynthesis

### (b) Water

Water is an essential raw material in photosynthesis. Only 1% of the absorbed water is utilised in photosynthesis.

### (c) Temperature

The rate of photosynthesis increases by increase in temperature upto 40°C. Above this temperature, there is a decrease in the photosynthesis. Similarly, low temperature also inhibits photosynthesis. The temperature affects photosynthesis by affecting the activity of enzymes.

### (d) Carbon-dioxide

Atmosphere is the main source of CO<sub>2</sub> for terrestrial plants.

In atmosphere CO<sub>2</sub> is present at the tune of 0.03%.

The rate of photosynthesis increases by increasing the concentration of CO<sub>2</sub>. But after a certain limit, the excess concentration of CO<sub>2</sub> proves to be toxic to the cells.

### (e) Oxygen

Over concentration of oxygen stops photosynthesis.



### Focus Point

**Bacterial Photosynthesis** : It is a special kind of photosynthesis in which solar energy is utilised for the synthesis of carbohydrates and H<sub>2</sub>S is the hydrogen donor instead of water as in normal photosynthesis. So O<sub>2</sub> is not liberated in bacterial photosynthesis.

e.g. – Chlorobium (Green sulphur), Chromatium (Purple sulphur), Rhodospirillum, Rhodopseudomonas (Purple non sulphur)



## EXERCISE – I

### ONLY ONE CORRECT TYPE

1. Chemosynthetic bacteria obtain energy from :  
(A) Sun (B) Infra-red rays  
(C) Organic substances  
(D) Inorganic chemicals mainly
2. A digestive enzyme, salivary amylase, in the saliva begin digestion of :  
(A) Protein (B) Nucleic acids  
(C) Fats (D) Carbohydrates
3. The visible part of electromagnetic spectrum lies in between :  
(A) X-ray and ultra-violet  
(B) Ultra violet and infra red  
(C) Infra red and microwave  
(D) X-ray and infra red
4. Partially digested food that leaves the stomach is called :  
(A) Chyle (B) Chyme  
(C) Bolus (D) None of these
5. Peristalsis occurs in  
(A) liver (B) ureter  
(C) alimentary canal (D) hypothalamus
6. Human beings have vestigial vermiform appendix. The ancestors must have been  
(A) insectivorous (B) herdivorous  
(C) carnivorous (D) sangivorous.
7. Which one of the following lacks enzymes ?  
(A) Pancreatic juice (B) Saliva  
(C) Bile (D) Intestinal juice
8. Liver stores glucose in the form of:  
(A) Starch (B) Glycogen  
(C) Protein (D) Cholesterol
9. Gastric juice contains:  
(A) Pepsin, lipase and rennin  
(B) Trypsin, lipase and rennin  
(C) Trypsin, pepsin and lipase  
(D) Trypsin, pepsin and rennin
10. Partial removal of liver is not harmful because:  
(A) Liver being a large organ can suffice the functions even if a part is removed  
(B) Liver is not a very essential organ of the body  
(C) Liver has regenerative capacity and will grow after partial hepatectomy  
(D) The function of liver can be taken over by kidneys
11. Insectivorous plants digest insects to get an essential nutrient. Other plants generally get this nutrient from the soil. What is this nutrient ?  
(A) Oxygen (B) Nitrogen  
(C) Carbon dioxide (D) Phosphates
12. Main function of HCl present in gastric juice is  
(A) digestion of starch  
(B) emulsification of fat  
(C) conversion of pepsinogen to pepsin  
(D) detoxification of harmful constituents of food
13. What is the substrate for lipase enzyme ?  
(A) Protein (B) Carbohydrate  
(C) Lipid (D) Nucleic acid
14. Succus entericus is the other name of  
(A) gastric juice (B) intestinal juice  
(C) bile juice (D) saliva
15. During prolonged fasting, the sequence of organic compounds used by body is:  
(A) Carbohydrates, fats, proteins  
(B) Fats, carbohydrates, proteins  
(C) Carbohydrates, proteins, lipids,  
(D) Proteins, lipids, carbohydrates



16. Absorption of glycerol, fatty acids and monoglycerides takes place by:
  - (A) Lymph capillaries within villi
  - (B) Walls of stomach
  - (C) Colon
  - (D) Capillaries within villi
17. Rennin acts on:
  - (A) Proteins in stomach
  - (B) Milk, changing casein into paracaseinate at 7.2 - 8.2 pH
  - (C) Fat in intestine
  - (D) Milk, changing casein into calcium paracaseinate at 1-3 pH.
18. The human intestine is long because:
  - (A) Bacteria in food can be killed gradually
  - (B) It provides more surface for food storage
  - (C) It increases surface area for absorption of food
  - (D) None of these
19. In the lunch, you ate boiled green vegetables, a piece of cooked meat, one boiled egg and a sugar candy. Which one of these foods may have been digested first?
  - (A) Boiled green vegetables
  - (B) The piece of cooked meat
  - (C) Boiled egg
  - (D) Sugar candy
20. Glycogenesis refers to
  - (A) conversion of glycogen to glucose
  - (B) breakdown of glucose to form pyruvate
  - (C) breakdown of pyruvate to form glucose
  - (D) conversion of glucose to glycogen
21. Casein is digested in children by -
  - (A) Rennin
  - (B) Renin
  - (C) Chymotrypsin
  - (D) Trypsin
22. Germs entering the body along with food are killed in where pH is
  - (A) 10
  - (B) 7
  - (C) 3
  - (D) 11
23. Which one of the following association is incorrect?
  - (A) Protein - Trypsin
  - (B) Fat - Lipase
  - (C) Maltose - Pepsin
  - (D) Starch - Amylase
24. Vitamin B<sub>6</sub> is also called
  - (A) Thiamine
  - (B) pantothenic acid
  - (C) pyridoxine
  - (D) retinol
25. Sometimes urea is fed to ruminates to improve their health. It works by
  - (A) Helping growth of gut microbes that break down cellulose
  - (B) Killing harmful microorganisms in their gut
  - (C) Increasing salt content in the gut
  - (D) Directly stimulating blood cell proliferation
26. During photosynthesis the oxygen in glucose comes from :
  - (A) Water
  - (B) Carbon dioxide
  - (C) Both from water and carbon dioxide
  - (D) Oxygen in air
27. A specific function of light energy in the process of photosynthesis is to :
  - (A) Activate chlorophyll
  - (B) Oxidation of CO<sub>2</sub>
  - (C) Synthesis of glucose
  - (D) Reduce CO<sub>2</sub>
28. Dark reaction in photosynthesis is called so because
  - (A) It does not require light energy
  - (B) Cannot occur during daytime
  - (C) Occurs more rapidly at night
  - (D) It can also occur in darkness

29. With regards to natural eating habits, a human is :

- (A) An herbivore (B) A carnivore  
(C) An omnivore (D) A Granivore

30. Where is bile produced :

- (A) In gall bladder (B) In blood  
(C) In liver (D) In spleen

**MATCH THE COLUMN TYPE**

31. Match the names of the glands listed under column I with the location given under column II and select the correct option from the codes given below:

**Column I**

**Column II**

- (P) Crypts of lieberkuhn (1) Loop of duodenum  
(Q) Pancreas (2) Stomach  
(R) Adrenal gland (3) Intestine  
(S) Gastric gland (4) Kidney.  
(A) P → 3, Q → 1, R → 4, S → 2  
(B) P → 1, Q → 2, R → 3, S → 4  
(C) P → 2, Q → 4, R → 3, S → 1  
(D) P → 3, Q → 4, R → 1, S → 2

*Space for Notes :*

## EXERCISE – II

### VERY SHORT ANSWER TYPE

1. What are heterotrophs ?
2. Define saprophyte ?
3. What is carnivore ?
4. Define digestion ?
5. What is ingestion ?
6. What is the mode of nutrition of *Amoeba* ?
7. How do the guard cells regulate opening and closing of stomatal pores ?
8. Is 'nutrition' a necessity for an organism ?

### SHORT ANSWER TYPE

1. Differentiate between an autotroph and a heterotroph ?
2. Differentiate between autotrophic and heterotrophic nutrition ?
3. Distinguish saprophytes from parasites.
4. Differentiate between photosynthetic and holozoic nutrition ?
5. How do saprophytic organisms obtain their nourishment ?
6. What is the importance of saprophytes ?
7. What is the action of hydrochloric acid of gastric juice ?
8. Name a digestive juice that has no enzymes. What is the role of this juice ?
9. Name the various parts of large intestine. What is the role of large intestine ?

### LONG ANSWER TYPE

1. Explain the mechanism of photosynthesis ?
2. Explain the mechanism of nutrition of *Amoeba* with the help of suitable diagram.
3. Describe the various types of heterotrophic nutrition.
4. Briefly describe the digestive system of humans
5. What happens to food in the small intestine ?

### TRUE / FALSE TYPE

1. Most of the digestion occurs in jejunum,
2. Enamel is the hardest substance of human body.
3. Pepsinogen requires alkaline medium to convert into pepsin.
4. Coprophagy is the consumption of faecal matter.
5. Bile emulsifies fat molecules.

### FILL IN THE BLANKS

1. .... is inverted U shaped tube in large intestine.
2. Liver secretes ..... which provides alkaline medium.
3. Oesophagus is also called as .....
4. *Amoeba* ingests its food with the help of .....
5. Dark reaction occurs in ..... of a chloroplast.

### Answer Key

#### EXERCISE-I

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
D	D	B	B	C	B	C	B	A	C	B	C	C	B	A
16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
A	D	C	D	D	C	C	C	C	A	B	A	D	C	C
31														
A														

#### EXERCISE – II

##### TRUE/FALSE TYPE

1. F      2. T      3. F      4. T      5. T

##### FILL IN THE BLANKS

1. Duodenum      2. Bile      3. Food pipe      4. Psudopodia      5. Stroma

## SELF PROGRESS ASSESSMENT FRAMEWORK

(CHAPTER : LIFE PROCESS & NUTRITION)

CONTENT	STATUS	DATE OF COMPLETION	SELF SIGNATURE
Theory			
In- Text Examples			
NCERT Exercises			
Exercise I			
Exercise II			
Short Note-1			
Revision - 1			
Revision - 2			
Revision - 3			
Remark			

### NOTES :

1. In the status, put “completed” only when you have thoroughly worked through this particular section.
2. Always remember to put down the date of completion correctly. It will help you in future at the time of revision.



*Space for Notes :*

A series of horizontal dotted lines providing space for notes.





# RESPIRATION

# 3

## **Concepts**

### ***Introduction***

#### **1. *Respiration***

##### ***1.1 Mechanism of Respiration***

##### ***1.2 Organs of Respirations***

##### ***1.3 Respiration in human***

##### ***1.4 Mechanism of Breathing***

##### ***1.5 Exchange of gases***

##### ***1.6 Cellular Respiration***

#### **2. *Respiration in Plants***

##### ***2.1 Mode of Gaseous Exchange***

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### ***Exercise – I (Competitive Exam Pattern)***

### ***Exercise – II (Board Pattern Type)***

### ***Answer Key***



## INTRODUCTION

All living organisms need energy to carry out their functions. The digested food is absorbed. The absorbed food components are subsequently assimilated in the body cells. These assimilated molecules hold energy in their chemical bonds. Their bond energy is released by oxidation in the cells. The process of oxidation is carried out with the help of oxygen.

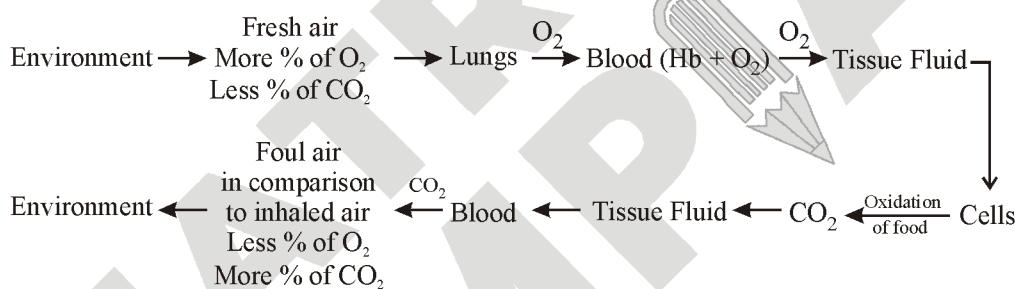
Energy is released in this process. This energy is trapped by forming bonds between ADP (Adenosine diphosphate) and inorganic phosphate (iP) to synthesize ATP (Adenosine triphosphate) molecules.

### BREATHING

The process involving intake of air or oxygen [inspiration] and removal of air or carbondioxide [expiration] is called breathing. No enzymes are involved in this process.

### RESPIRATION

The process of respiration involves taking in oxygen (of air) into the cells, using it for releasing energy by burning food, and then eliminating the waste products (carbon dioxide and water) from the body.



Flow chart of Respiration

### Differences Between Breathing and Respiration :

BREATHING	RESPIRATION
1. It is a physical process. It involves inhalation of fresh air and exhalation of foul air.	It is a biochemical process. It involves exchange of respiratory gases and also oxidation of food.
2. It is an extracellular process.	It is both an extracellular as well as intracellular process.
3. It does not involve enzyme action.	It involves a number of enzymes required for oxidation of food.
4. It does not release energy, rather it consumes energy.	It releases energy.
5. It is confined to certain organs only	It occurs in all the cells of the body.

## 1. RESPIRATION

Oxidation of carbohydrates during respiration is not a single reaction because there is no enzyme that can catalyze the complete oxidation of glucose into carbon dioxide and water in a single step. Instead, the oxidation of glucose consists of a sequence of reactions. In such step wise oxidation energy is released slowly. It allows cells to capture more energy. It would not be possible if the energy is released in one big burst.

### 1.1 MECHANISM OF RESPIRATION

The mechanism of respiration involves following two processes :

- Glycolysis – a series of reactions which does not require oxygen and by which glucose molecule is broken into pyruvic acid.
- Further breakdown of pyruvic acid molecules by aerobic (in the presence of oxygen) or anaerobic (in the absence of oxygen) methods.

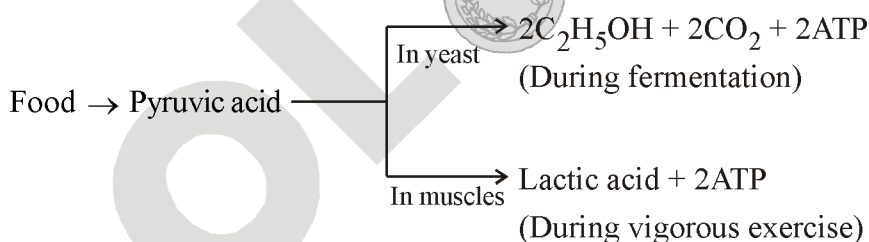
#### A. AEROBIC RESPIRATION :-

##### Breakdown of pyruvic acid in the presence of oxygen :

In the presence of oxygen the pyruvic acid is completely oxidised and  $\text{CO}_2$  and  $\text{H}_2\text{O}$  are formed as the end products. This oxidation is carried out by a cyclic series of reactions known as **tricarboxylic acid cycle** or **citric acid cycle** or **Krebs cycle**. All reactions of Krebs cycle occur within mitochondria. Complete oxidation of each pyruvic acid molecule produces 15 ATP molecules, therefore, **aerobic oxidation of each glucose molecule produces** :  $15 \times 2 = 30$  ATP (from Krebs cycle) + 8 ATP (from glycolysis) = 38 ATP

#### B. ANAEROBIC RESPIRATION :-

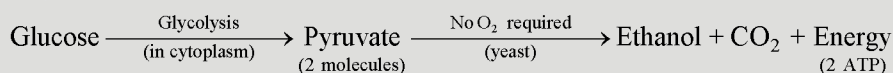
When oxidation of food material does not require oxygen or it occurs in absence of oxygen, it is called as Anaerobic Respiration.



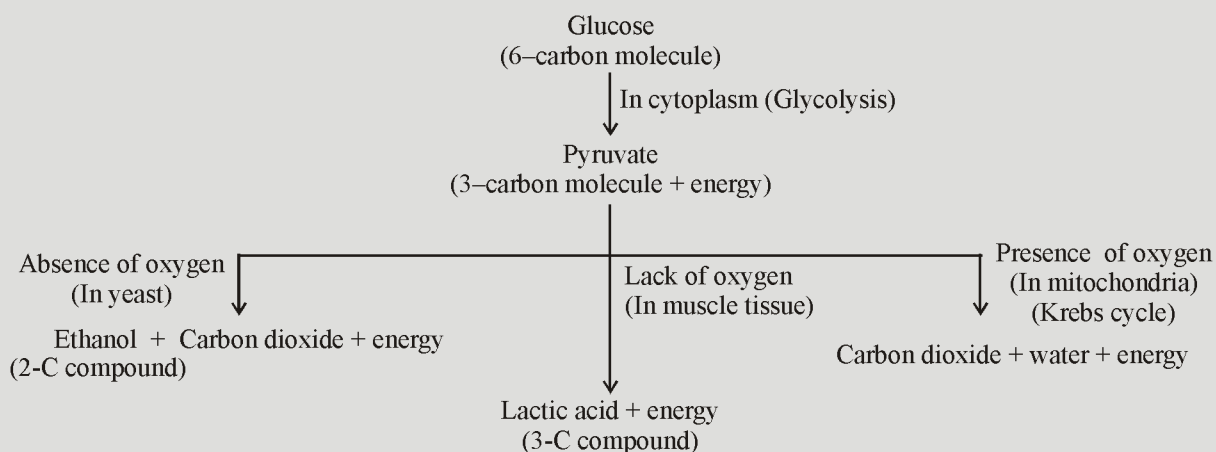


## Focus Point

**Fermentation :** It is a kind of anaerobic respiration in which the microorganisms break down glucose into ethyl alcohol and carbondioxide and energy is released.



## BUILD THE CONCEPT



## 1.2 ORGANS OF RESPIRATIONS

- (i). **Skin** or general body surface, as in earthworm.
  - (ii). **Air tubes** or **trachea**, as in insects (grasshopper, cockroach, housefly)
  - (iii). **Gills** as in aquatic animals like fish and prawn.
  - (iv). **Lungs** as in land animals like frog, lizard, birds, rat, humans.
- ⇒ Frog respire through skin as well as lungs (being amphibious).

(i).	Amoeba (Protozoa)	Diffusion : Exchange of gases takes place through general body surface.
(ii).	Earthworm (Annelida)	Cutaneous Respiration : Exchange of gases occur through moist skin.
(iii).	Fish (Pisces)	Branchial Respiration : Exchange of gases through gills.
(iii).	Grasshopper (Arthropoda)	Tracheal Respiration : Exchange of gases through spiracles.



## Focus Point

It is worth noting that all respiratory organs whether skin, trachea, gills or lungs have three common features.

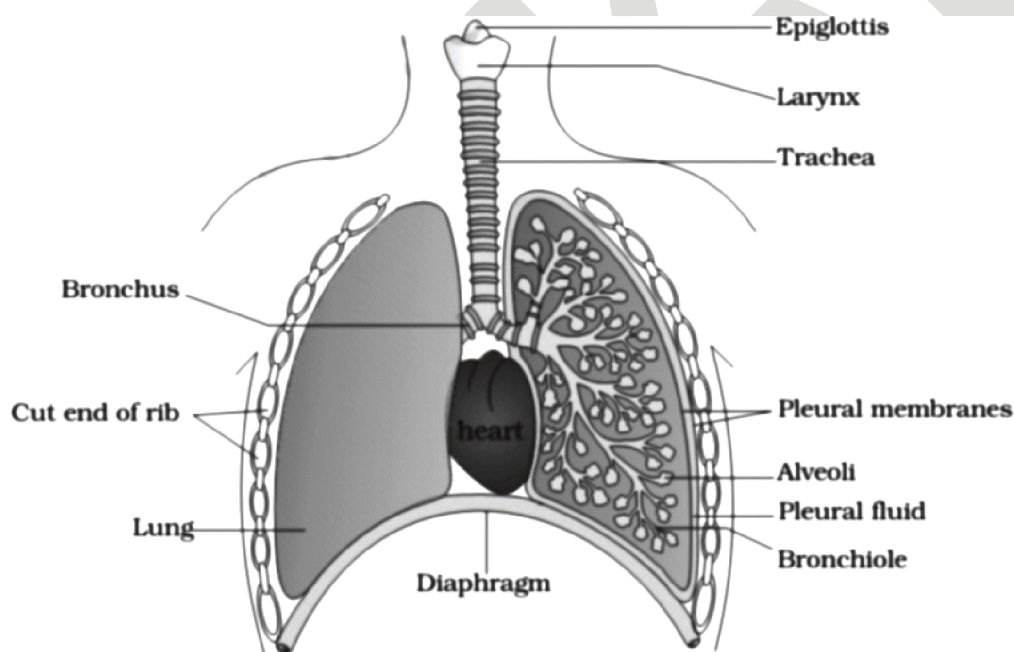
(a) All the respiratory organs have a large surface area so as to get enough oxygen.

(b) All have thin walls for easy diffusion and exchange of respiratory gases.

(c) All respiratory organs have moist surface.

### 1.3 RESPIRATION IN HUMAN

External nostrils → Nasal cavity → Pharynx → Larynx → Trachea → Bronchi  
→ Bronchioles → Alveolar sacs.



**Figure. 1 . Respiration in Humans**

- **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. Nasal septum is a cartilage which divides nasal cavity into two nasal chambers.
- **Internal nares :** Nasal cavity opens into it and it leads to pharynx
- **Pharynx :** It is a common part between both alimentary canal and respiratory system.
- **Laryngopharynx :** It is the lower part of pharynx and has a slit like aperture called glottis, which can be closed by a leaflike bilobed cartilage epiglottis, during swallowing of food bolus.

- **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 cartilage among them a 'c' shaped thyroid cartilage protruding out in neck region is called Adam's apple.
- **Trachea (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.
- **Bronchi** : trachea is branched into two bronchi left and right each of which enters into the lungs.
- **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.
- **Diaphragm** : It is a sheet of muscles that lies below the lungs and separates thoracic cavity from abdominal cavity.

#### 1.4 MECHANISM OF BREATHING

**(a) Inhalation (Inspiration)** :- Inhalation is intake of fresh air from outside into the alveoli of the lungs. It occurs by expansion of lungs which is brought about by enlargement of thoracic cavity. Inhalation involves the following steps:-

1. The diaphragm ( a sheet of tissue that separates thoracic cavity from abdominal chamber) muscle contracts so that the diaphragm lowers down and becomes flat.
2. lowering of diaphragm pushes the abdominal viscera downward resulting in the enlargement of thoracic cavity vertically.
3. External intercostal muscles contract so that the ribs and sternum are pulled upward and outward. This causes enlargement of thoracic cavity.
4. Enlargement of thoracic cavity results in the expansion of lungs.
5. Expansion of lungs reduces the pressure of air inside so that the fresh air is pulled from outside into the lungs passing through nostrils, trachea and bronchi.
6. Fresh air has a rich supply of  $O_2$  which goes into the blood passing through thin membranes of alveoli and blood capillaries. As a result the blood in the capillaries becomes loaded with oxygen and expels carbon dioxide into the alveoli for exhalation.

**(b) Exhalation [Expiration]** :- The mechanism of breathing out of carbon dioxide is called exhalation.

1. During exhalation, the phrenic muscle of the diaphragm relaxes so that the abdominal viscera pushes the diaphragm upward, making it convex.
2. The external intercostal muscles also relax with the result the thoracic cavity is reduced in size and lungs also contract.
3. Contraction of lungs raises the air pressure so that the foul air moves out.

An average rate of breathing in a normal adult man is 15 to 18 times per minute.



### Movement involved in mechanism of respiration

Part / Parameter	Inhalation	Exhalation
Diaphragm	Contracts	Relaxes
	Flattens downwards	Becomes Dome shaped
Rib cage	Moves upwards and outwards	Moves downwards and inwards
Thoracic cavity	Increases	Decreases
Air pressure of thorax and lungs	Decreases	Increases
External intercostal muscles	Contract	Relax

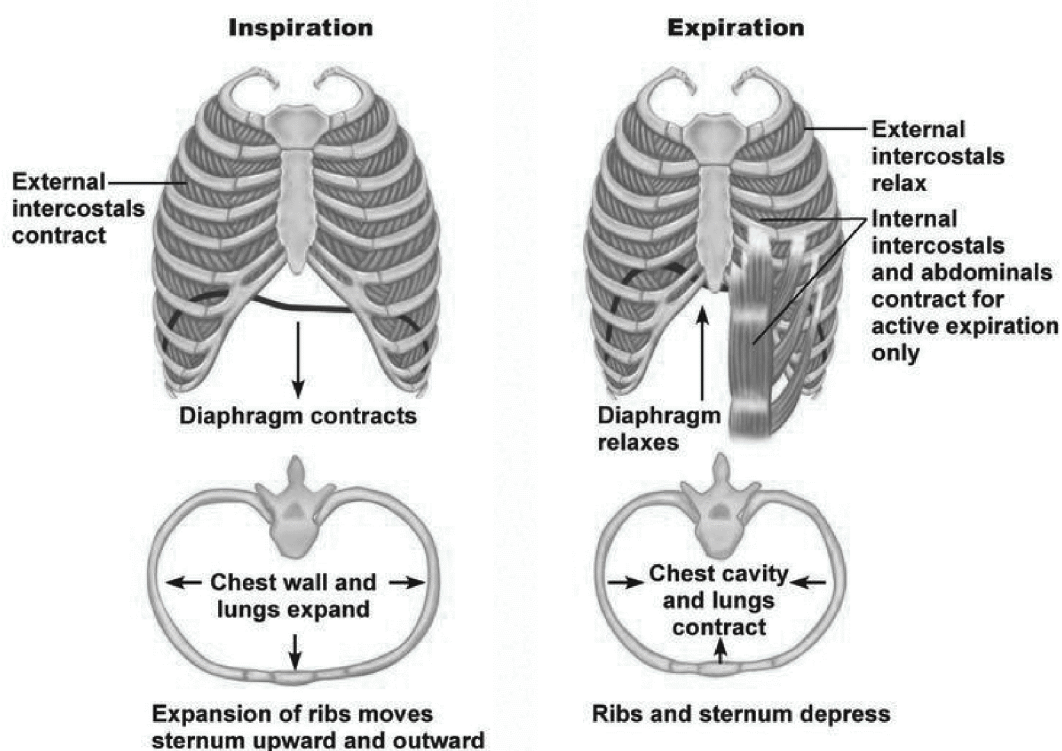


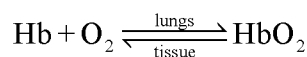
Figure : Diagram representing inspiration and expiration

## 1.5 EXCHANGE OF GASES

This exchange of gases is done by blood as following :

⇒ **Transportation of O<sub>2</sub>** : The O<sub>2</sub> that diffuses into the blood from the lungs is transported to body tissues in the following form :

(i) About 97% of the O<sub>2</sub> that diffuses into the blood combines with haemoglobin of RBCs forming an unstable compound, oxyhaemoglobin.

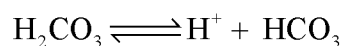


(ii) The remaining 3% O<sub>2</sub> dissolves into water of plasma.

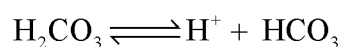
- A normal person has about 15 grams of haemoglobin per 100 ml of blood.
- If diffusion were to move oxygen in our body it would take 3 years for a molecule of oxygen to get our toes from our lungs.

⇒ **Transportation of CO<sub>2</sub>:**

- Carbon dioxide is also transported by haemoglobin. When a respiring tissue releases carbon-dioxide it is first diffused in the plasma. From here it diffuses into the red blood cells.
- 70 % Carbon-dioxide is transported from the tissues to the lungs in the form of bicarbonates dissolve in blood plasma.



Carbonic acid

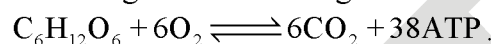


Bicarbonate ion

- About 23% of carbon dioxide entering into the erythrocytes combines with the globin (protein) haemoglobin to form carbaminohaemoglobin, which is transported to the lungs.

## 1.6 CELLULAR RESPIRATION

The biological oxidation of glucose in the cells is called cellular respiration.



The oxidation of glucose is a multistep process and is completed in a series of chemical reaction. Each step is catalysed by a particular enzyme. The energy released as a result of the oxidation of glucose is stored in the form of ATP molecules. Water being an important part of the body is retained in the body. CO<sub>2</sub> being toxic beyond a certain limit needs to be eliminated.

- Exchange of O<sub>2</sub> and CO<sub>2</sub> between the blood and body tissues is called internal or tissue respiration. The O<sub>2</sub> from the blood diffuses into the body tissues whereas CO<sub>2</sub> from tissues to the blood because of higher concentration of CO<sub>2</sub> in the body tissues, produced due to cellular respiration. It refers to 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 3 steps :

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

**(i) Glycolysis :** Glycolysis is also called as EMP (Embden, Meyerhof, Parnas) pathway, Site- Cytoplasm of cell.

- In this cycle glucose is converted into pyruvic acid in presence of many enzymes and co-enzyme
- Oxygen is not required during glycolysis.
- There is no production of CO<sub>2</sub> during this process.

**(ii) Krebs Cycle:**

**Site : Mitochondria of cell**

- ◆ Also called aerobic oxidation.
- ◆ Discovered by Sir Hans Krebs.
- ◆ Another name TCA cycle (tricarboxylic acid cycle) or Citric acid cycle.
- ◆ It brings about the conversion of pyruvic acid, fatty acids, fats and amino acids into CO<sub>2</sub> and water by oxidation. It is the common path for oxidation of carbohydrates, fats and proteins.

**(iii) Electron Transport System or ETS:**

- ♦ In this hydrogen atoms produced during oxidation of various intermediates during kreb cycle are first broken into protons and electrons.
- ♦ These protons and electrons after passing through a series of coenzymes and cytochromes combine with oxygen to form water molecules.

**Location, structure and function of respiratory system**

Organ or region	Location	Structure and function
Nasal cavity	Above the mouth cavity	<ul style="list-style-type: none"> <li>• Two external nostrils help in intake of oxygen</li> </ul>
		<ul style="list-style-type: none"> <li>• Lined by ciliated and sensory epithelial cells which help in filtering of air (by hair) and warming or cooling of the inhaled air.</li> </ul>
		<ul style="list-style-type: none"> <li>• Mucous secreted by them prevent dust particles for entry.</li> </ul>
		<ul style="list-style-type: none"> <li>• Two internal nostrils act as the end of this cavity from which the air enters into pharynx</li> </ul>
Pharynx	Behind the nasal cavity leading into the trachea	<ul style="list-style-type: none"> <li>• Posteriorly it has two openings ; dorsal opening or gullet (leading to oesophagus) and ventral opening or glottis (aperture of trachea).</li> </ul>
		<ul style="list-style-type: none"> <li>• A cartilaginous flap (epiglottis) guards the glottis to prevent the entry of food into the trachea.</li> </ul>
Larynx or voice box or adam's apple	Lies at the back of the neck	<ul style="list-style-type: none"> <li>• A pair of membranes (called vocal cords) stretched in the internal cavity, partially close the air passage. These membranes can be relaxed or stretched. When the air passes over the vocal cords, they vibrate and produce sounds.</li> </ul>
Trachea or Wind pipe	Tube running through the neck in front of oesophagus	<ul style="list-style-type: none"> <li>• Its walls are supported by C-shaped cartilages to prevent it from collapsing. It divides into two bronchi (singular bronchus) which enter the respective right and the left lung.</li> </ul>
Lungs	Present in the thoracic cavity	<ul style="list-style-type: none"> <li>• Surrounded by two pleural membranes containing a fluid in between to reduce friction.</li> </ul>
		<ul style="list-style-type: none"> <li>• Spongy organ formed by the sub-divisions of the bronchus called bronchioles.</li> </ul>
		<ul style="list-style-type: none"> <li>• Each bronchiole ends in a structure like bunch of grapes or balloon-like structures called alveoli or air sacs. Alveoli provide the surface for the exchange of gases.</li> </ul>
		<ul style="list-style-type: none"> <li>• Each alveolus is surrounded by a network of blood capillaries.</li> </ul>

## 2. RESPIRATION IN PLANTS

The plants do not have any special respiratory system so they have to respire in all of their individual parts like leaf, stem and root.

The plants also have to exchange gases with the atmosphere by simple diffusion process.

### 2.1 MODE OF GASEOUS EXCHANGE

In terrestrial plants gaseous exchange occurs through

- ♦ Stomata – In leaves and green stem
- ♦ Lenticels – In woody stem and roots.
- ♦ Root hairs – In young roots.

**(a) Respiration through stomata :** Stomata are small apertures found on the surface of leaf. For the process of respiration, oxygen enters stomata by the process of diffusion and then into other cells of the leaf. When concentration of  $\text{CO}_2$  increases inside the cells it is diffused out through stomata.

**(b) Respiration through lenticels :**

Lenticels are the opening in the bark of woody stems. They also serve as a place of gaseous exchange.

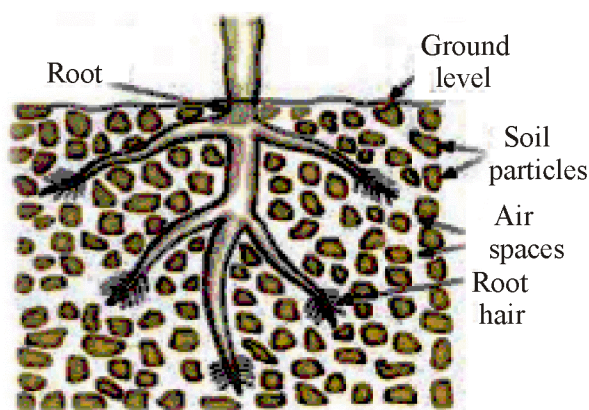
**(c) Respiration through general surface of the roots :**

Ploughing or tilling of the soil creates small air spaces around soil particles which provides the sources of oxygen for the roots.

This oxygen present between the soil particles diffuses into root hairs (these are the extensions of epidermal cell of the root), by the process of diffusion.

From the root hairs, oxygen diffuses into other cells of the root. After utilisation of oxygen,  $\text{CO}_2$  is diffused out into the soil.

In **older roots** there are no root hairs present. Instead they have layer of dead cells which is protective in nature and encloses small opening (lenticels). These are used for gaseous exchange between soil and inner living cells.



*Figure : Respiration through general surface of the roots*



## Focus Point

- ♦ Aquatic plants can carry out gaseous exchange by diffusion over their whole surfaces.
- ♦ Direction of diffusion depends upon the environmental condition and the requirement of the plant.
- ♦ During the day time  $O_2$  release is the major event.
- ♦ During night  $CO_2$  release is the major event because there is no photosynthesis.



## BUILD THE CONCEPT

### DIFFERENCES BETWEEN RESPIRATION IN PLANTS AND ANIMALS

S. No.	Respiration in plants	S. No.	Respiration in animals
1	Respiration is carried out by all parts of the plant i.e., roots, stem, leaves.	1	Respiration occurs only in the respiratory organs.
2	It occurs at slower rate.	2	It is faster in animals.
3	In plants, there is little transport of gases to various part of the plant.	3	Transport of gases to various parts is more.
4	Products of anaerobic respiration of glucose in plants are ethanol and $CO_2$ .	4	Products of anaerobic respiration of glucose is lactic acid and no $CO_2$ .
5	There is no special gas transport system.	5	Blood transports oxygen.
6	Green plants have additional oxygen source from photosynthesis.	6	Animals do not have any additional source of oxygen.

## EXERCISE – I

### ONLY ONE CORRECT TYPE

1. Which one is anabolic process -  
(A) Respiration (B) Digestion  
(C) Photosynthesis (D) Ascent of sap
2. A catabolic process is -  
(A) Absorption of minerals  
(B) Ascent of sap  
(C) Respiration  
(D) Assimilation
3. Exchange of gasses occurs through  
(A) Stomata (B) Lenticles  
(C) Root surfaces (D) All of the above
4. Glycolysis occurs in -  
(A) Cytoplasm (B) Mitochondria  
(C) Chloroplasts (D) Golgi complex
5. Krebs cycle operates in -  
(A) Endoplasmic reticulum  
(B) Chloroplasts  
(C) Golgi bodies  
(D) Mitochondria
6. Which one is a product of glycolysis -  
(A) Oxaloacetate (B) Pyruvate  
(C) Ethyl alcohol (D) Lactic acid
7. Adam's Apple occurs in -  
(A) Buffaloes (B) Dogs  
(C) Human males (D) Human females
8. Muscular partition present between thorax and abdomen is -  
(A) Pericardium (B) Pleura  
(C) Epiglottis (D) Diaphragm
9. Covering of lungs is -  
(A) Pleura (B) Pericardium  
(C) Epiglottis (D) Capsule
10. Gaseous exchange occurs in the lungs in the region of -  
(A) Trachea (B) Bronchi  
(C) Bronchioles (D) Alveoli
11. Trachea and bronchi have -  
(A) C-shaped cartilaginous rings  
(B) Complete cartilaginous rings  
(C) Complete chitinous rings  
(D) C-shaped chitinous rings
12. Respiratory tract is lined by ciliated epithelium. The function of cilia is to -  
(A) Trap dust  
(B) Trap germs  
(C) Push out mucus with trapped germs and dust  
(D) Push in air vigorously
13. If the thoracic wall but not the lungs is punctured -  
(A) The lungs get inflated  
(B) The man dies as the lungs get collapsed  
(C) The breathing rate decreases  
(D) The breathing rate increases
14. Skin is an ideal respiratory organ in frog because it is  
(A) Highly vascular  
(B) Kept moist  
(C) Devoid of hair and scales  
(D) All the above



15. Respiration is -
  - (A) Anabolic and exergonic
  - (B) Anabolic and endergonic
  - (C) Catabolic and exergonic
  - (D) Catabolic and endergonic
16. Glycolysis occurs in -
  - (A) Anaerobic organisms
  - (B) Muscle cells
  - (C) Prokaryotic cells
  - (D) Almost all the cells
17. The blood coming out of lungs is richer than that entering into lungs in -
  - (A)  $\text{CO}_2$
  - (B)  $\text{O}_2$
  - (C) Both
  - (D) None of these
18. Anaerobic respiration is likely to occur in -
  - (A) Ants
  - (B) Earthworms
  - (C) Echinoderms
  - (D) Tapeworms
19. Respiratory quotient is -
  - (A)  $\text{CO}_2 / \text{CO}_2$
  - (B)  $\text{O}_2 / \text{CO}_2$
  - (C)  $\text{CO}_2 / \text{N}_2$
  - (D)  $\text{N}_2 / \text{CO}_2$
20. Epiglottis guards the opening of -
  - (A) Eustachian tube
  - (B) Glottis
  - (C) Lungs
  - (D) Internal ear
21. Skin is an accessory respiration in -
  - (A) Humans
  - (B) Frog
  - (C) Rabbit
  - (D) Lizard
22. The process of respiration is -
  - (A) Anabolic
  - (B) Catabolic
  - (C) Metabolic
  - (D) Anaerobic
23. Lungs are covered with the covering of -
  - (A) Pleural membrane
  - (B) Pericardium
  - (C) Peritoneum
  - (D) Mucous membrane
24. The respiratory pigment in the mammalian blood is
  - (A) Haemocyanin.
  - (B) Haemoerythrin.
  - (C) Haemoglobin.
  - (D) Fucoxanthin.
25. Breakdown of takes place in
  - (A) Golgi bodies
  - (B) Chloroplast
  - (C) Mitochondria
  - (D) Nucleus
26. The full form of ATP is
  - (A) Adenosine tetra phosphate.
  - (B) Adenosine tri phosphate.
  - (C) Adenylate tri phosphate.
  - (D) Adenylate tetra phosphate.
27. Alveoli of lungs in human body help in the exchange of gases as they
  - (A) Provide a surface for the exchange of gases.
  - (B) Do not provide any surface.
  - (C) Bring gases from nostrils to the lungs.
  - (D) Bring gases from lungs to the nostrils.
28. Breakdown of glucose is the first step of
  - (A) Respiration.
  - (B) Reproduction
  - (C) Excretion.
  - (D) Digestion.
29. Breakdown of pyruvate using oxygen takes place in
  - (A) Golgi bodies.
  - (B) Chloroplast
  - (C) Mitochondria.
  - (D) Nucleus
30. The rate of respiration in aquatic organisms is
  - (A) Slower than the rate of respiration in terrestrial organisms.
  - (B) Faster than the rate of respiration in terrestrial organisms.
  - (C) Faster than the rate of respiration in aerial organisms.
  - (D) Lower than the rate of respiration in aerial organisms.

**MATCH THE COLUMN TYPE**

31. Column I

(P) Asthma

(Q) Pneumonia

(R) Pleurisy

(S) Emphysema

Column II

(1) Smoking

(2) Obstruction in  
Breathing

(3) Bacterial and viral  
infection

(4) Inflammation of lung  
membrane

(A) P → 1, Q → 3, R → 4, S → 2

(B) P → 2, Q → 3, R → 4, S → 1

(C) P → 1, Q → 2, R → 4, S → 3

(D) P → 1, Q → 2, R → 3, S → 4

*Space for Notes :*

## EXERCISE – II

### VERY SHORT ANSWER TYPE

1. What is the shape of diaphragm during expiration?
2. What are stomata?
3. Name the energy currency of living system.
4. What is the shape of cartilaginous rings in trachea/
5. Name the common passage for food and air.

### SHORT ANSWER TYPE

1. What is respiration? What are its types?
2. What is diaphragm? Where is it located?
3. Define glottis and epiglottis.
4. What is inspiration and expiration?
5. What are the functions of nasal passage?

### LONG ANSWER TYPE

1. How respiration different from breathing?
2. Explain the processes for 'aerobic' respiration and 'anaerobic' respiration.
3. Draw a diagram showing 'human respiratory system'. Label its following parts  
(i) Larynx      (ii) Trachea      (iii) Lungs
4. What is breathing? How does it take place in man?
5. Describe the three pathways of glucose breakdown in living organisms.

### TRUE / FALSE TYPE

1. Amoeba respire through skin.
2. Aerobic respiration does not require oxygen.
3. Respiratory centre is in Medulla Oblongata.
4. Expiration is intake of oxygen.
5. The oxidation of one molecule of glucose produces 38 ATP molecules in aerobic respiration.

### FILL IN THE BLANKS

1. Nasal cavity contains ..... & ..... which entrap the dust particles.
2. Earthworm respire through ..... type of respiration.
3. Food  $\xrightarrow[\text{In cytoplasm}]{\text{.....}}$  Pyruvic acid.
4. Fish respire through ..... type of respiration.
5. Breathing is a ..... phenomenon whereas cellular respiration is ..... phenomenon.

### Answer Key

EXERCISE-I														
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
C	C	D	A	D	B	C	D	A	D	A	C	B	D	C
16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
D	B	D	A	B	B	B	A	C	C	B	A	A	C	B
31														
A														

EXERCISE – II									
TRUE/FALSE TYPE									
1.	F	2.	F	3.	T	4.	F	5.	T
FILL IN THE BLANKS									
1. Hair		2. Body Surface		3. Glycolysis		4. Branchial			
5. Physical Gland		Chemical							

## SELF PROGRESS ASSESSMENT FRAMEWORK

(CHAPTER : RESPIRATION (LIFE PROCESS))

CONTENT	STATUS	DATE OF COMPLETION	SELF SIGNATURE
Theory			
In- Text Examples			
NCERT Exercises			
Exercise I			
Exercise II			
Short Note-1			
Revision - 1			
Revision - 2			
Revision - 3			
Remark			

### NOTES :

1. In the status, put “completed” only when you have thoroughly worked through this particular section.
2. Always remember to put down the date of completion correctly. It will help you in future at the time of revision.



*Space for Notes :*

A series of horizontal dotted lines providing space for notes.





# TRANSPORTATION

# 4



## INTRODUCTION

All living bodies need nutrients and oxygen in every cell for its various tissues to sustain life.

Transport is a life process in which a substance absorbed (or made) in one part of the body of an organism is carried to other parts of its body.

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. Special tissues and organs are needed for the transport of substances in plants and animals because these tissues and organs can pick up the essential substances like food, oxygen, water, etc., at one end of their body and carry them to all other parts.

## 1. TRANSPORTATION IN HIGHER PLANTS

The higher plants have specialized system for the transportation of materials inside the body. This system is called vascular system or vascular tissues of the plants.

**Vascular tissue :** The vascular tissue consists of xylem and phloem.

**(A) Xylem :** Xylem contains four type of cells:-

- (i) Xylem tracheids
- (ii) Xylem vessels
- (iii) Xylem parenchyma
- (iv) Xylem sclerenchyma

- **Function :** It helps in transportation of water and minerals which is called “**ascent of sap**”. It helps in providing mechanical support.
- Transportation of water-
- **Transpiration :** The evaporation of water from the leaves of a plant is called transpiration. The continuous evaporation of water (or transpiration) from the cells of a leaf creates a kind of suction which pulls up water through the xylem vessels. Only 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 :

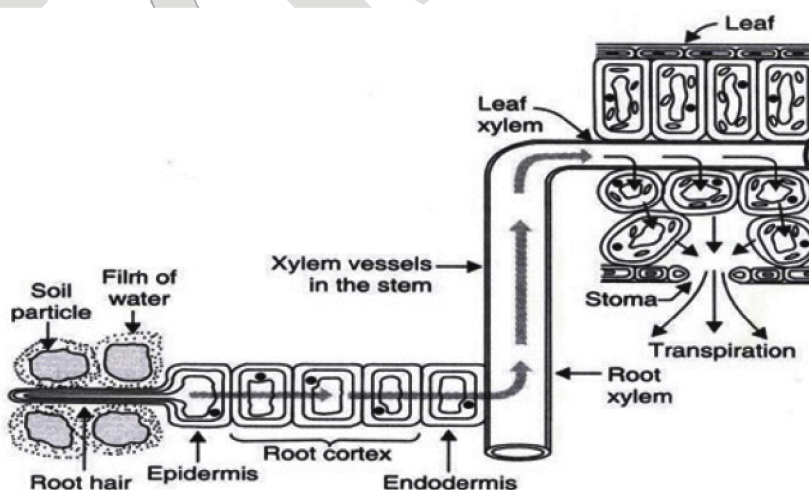
- (i) **Cuticular transpiration** (through cuticle) - 3-9% of total transpiration.
- (ii) **Lenticular transpiration** (through lenticels) - 0.1% of total transpiration.
- (iii) **Stomatal transpiration** (through stomata) - 80-90% of total transpiration.

**Importance of transpiration :**

- It helps in absorption of water & minerals from the soil.
- It regulates the temperature of the plant.
- 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.

**Transpiration cohesion Theory :**

- The main loss of water is through stomatal transpiration.
- 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).



*Figure : Leaf of plant*

**(B) Phloem :** Phloem consists of four type of cells

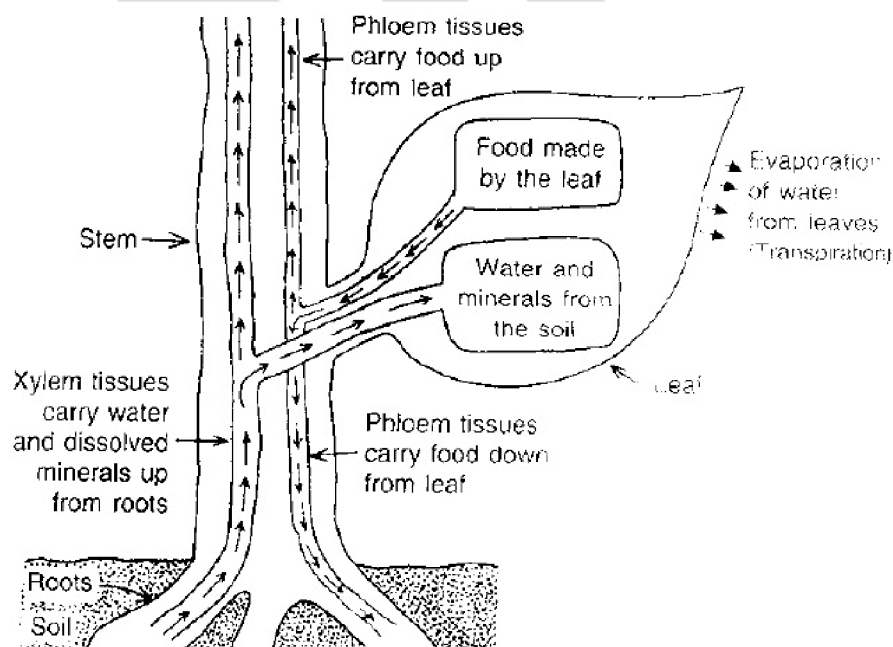
- (i) Sieve tubes
- (ii) Companion cells
- (iii) Phloem parenchyma
- (iv) Phloem sclerenchyma

- **Function :** It helps in transportation of food.

**Translocation :**

Phloem translocates the manufactured food (in the form of sucrose) from the leaves to the different parts of the plant.

DIFFERENCES IN FUNCTIONING OF XYLEM & PHLOEM		
S.NO.	XYLEM	PHLOEM
1.	Xylem parenchyma only living cell remaining cells are dead.	Phloem sclerenchyma only dead cell remaining all cells are living.
2.	It carries minerals, salts and water.	An organic solution of sugars is translocated.
3.	The movement is only upward.	The movement can be upward or downward.



*Figure : Transportation of food*

## 2. TRANSPORTATION IN ANIMALS

In higher animal two type of Circulatory system is present :

(i) Open Circulatory system (ii) Closed Circulatory system.

S.NO.	CHARACTERS	OPEN CIRCULATORY SYSTEM	CLOSED CIRCULATORY SYSTEM
1.	Occurrence	In some annelids, most of molluscs and arthropods.	In most of annelids, cephalopods, molluscs and all vertebrates.
2.	Position of blood	Blood does not remain confined in the blood vessels and comes in lacunae or sinuses.	Blood remains confined in the blood vessels.
3.	Blood pressure	Blood flows at low pressure and cannot be regulated.	Blood flows at high pressure and can be regulated.
4.	Velocity of blood	Blood flows at a low velocity	Blood flows at a high velocity
5.	Exchange of materials	Direct exchange between blood and body cells	Exchange occurs through the tissue fluid.
6.	Respiratory pigment	When present, it is dissolved in blood plasma.	Always present and is usually present in RBCs e.g. vertebrates.
7.	Efficiency	Less efficient as blood takes more time to complete one circulation	More efficient as blood circulation is completed in short period.

### Transportation in Humans :

- In humans there is a circulatory system that uses blood or lymph as carriers of materials (fluid exchange medium).
- Circulatory system consists of blood vascular system (blood as carrier) and lymphatic system (lymph as carrier).

#### (A) Blood Vascular System :

- Blood vascular system consists of blood, blood vessels and heart.
- 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 materials and carbon dioxide.
- The blood acts as the circulatory fluid.

**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 litre of blood.
- The main components of blood are :  
(I) Plasma (II) Blood corpuscles

- The formation of blood is called “**Haemopoiesis**”.

**(I) Plasma :** The liquid part (or fluid part) of blood is called plasma.

- **Note : Serum** is plasma from which fibrinogen is removed.

**(II) Blood Corpuscles :** Blood corpuscles are of three types.

**(i) Red Blood Corpuscles (RBCs) or Erythrocytes :**

- Mammalian RBC is a biconcave / disc-like structure devoid of nucleus.
- The number of RBCs is about 5-5.5 million per  $\text{mm}^3$  of blood (RBC count).
- The mammalian erythrocytes (RBCs) do not possess nuclei, mitochondria and endoplasmic reticulum. The erythrocytes contain haemoglobin.
- Haemoglobin consists of globin (protein) and  $\text{Fe}^{2+}$  (haem).
- 100 ml of blood contains 15 gm of haemoglobin. if the amount of haemoglobin in blood is less, the person suffers from anaemia.
- Haemoglobin content of normal human male is  $14.5 \pm 2$  gram percent, while it is  $12 \pm 2$  gram percent in a normal human female.
- The haemoglobin carries oxygen to the different cells of the body.
- The life span of a RBC is 120 days.

**(ii) White Blood Corpuscles (WBCs) or Leucocytes :** White blood cells are called as soldiers of the body. This is because they protect the body from the attack of disease-causing germs (pathogens) and other harmful foreign materials.

- The life span of a RBC is 120 days.
- These are rounded or amoeboid-shaped, nucleated and non pigmented cells.
- These are less in number than RBCs.
- These are 5000–10000 per  $\text{mm}^3$  of blood (WBC count).
- The number of leucocytes increases in infections like pneumonia, blood cancer (Leukaemia) etc.
- These are large in size than RBCs and contain nucleus. White blood corpuscles are of two types

**(a) Granulocytes :** In granulocytes the cytoplasm contains granules and the nucleus is multilobed. Neutrophils, Basophils and Eosinophils are three different types of granulocytes.

**(b) Agranulocytes :** Monocytes and lymphocytes are two different types of agranulocytes. Lymphocytes secrete antibodies which destroy microbes.

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

**Blood Clotting :** Blood forms a clot at the site of injury and thus prevents the further loss of blood.

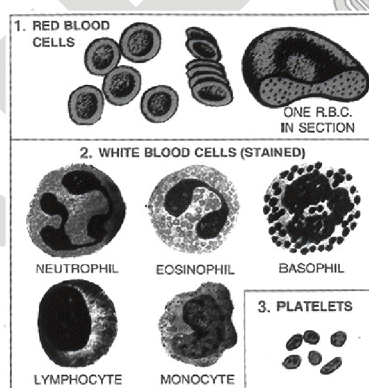
- Thromboplastin changes prothrombin of blood plasma into thrombin.
- Thrombin converts soluble protein fibrinogen to insoluble fibrin.
- Fibrin forms a network which entangles RBCs and blood platelets to form plug or clot over the injured area.
- Blood clotting is usually completed within 8-15 minutes.

Injured tissue + Blood platelets  $\longrightarrow$  Thromboplastin released

Prothrombin  $\xrightarrow[\text{Ca}^{++}]{\text{Thromboplastin}}$  Thrombin

Fibrinogen  $\xrightarrow{\text{Thrombin}}$  Fibrin  
(Soluble) (Insoluble)

Fibrin + Red blood corpuscles  $\longrightarrow$  Clot of blood



*Figure : Different types of cells present in blood*

**Functions of Blood :** Blood performs the following functions :

- **Transportation 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 substances.
- **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.
- **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.
- **Protection from diseases :** The WBCs ( 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.

### Blood Groups :

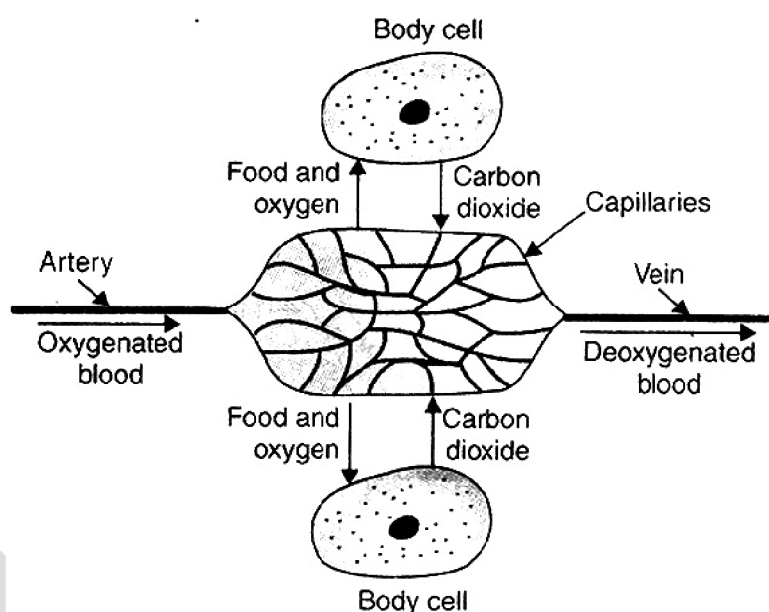
- Landsteiner discovered that blood of different individuals did not match each other but there were biochemical differences.
- He discovered Antigens A and B and blood groups (ABO systems).
- Antigen (agglutinin) is a glycoprotein present on RBCs. For each antigen there is a corresponding antibody. 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.

Allele from Parent 1	Allele from Parent 2	Genotype of offspring	Blood types of offspring
$I^A$	$I^A$	$I^A I^A$	A
$I^A$	$I^B$	$I^A I^B$	AB
$I^A$	$i$	$I^A i$	A
$I^B$	$I^A$	$I^A I^B$	AB
$I^B$	$I^B$	$I^B I^B$	B
$I^B$	$i$	$I^B i$	B
$i$	$i$	$ii$	O

**Blood Vessels :** These are hollow tubes through which the blood flows.

- (1) **Arteries :** These are thick walled and deep seated blood vessels which generally carry the oxygenated blood away from the heart to various body parts.

- (2) **Veins** : These are thin walled and superficially located blood vessels which generally carry deoxygenated blood from the body parts to heart.
- (3) **Capillaries** : The capillaries are thin walled and extremely narrow tubes or blood vessels which connects arteries to veins. The exchange of various materials like oxygen, food , carbon dioxide, etc. between the blood and the body cells takes place through capillaries. Arteries are joined to veins through a network of very thin blood vessels called capillaries. Food and oxygen go from blood into body cells through capillaries. Waste materials (like carbon dioxide) go from body cells into the blood through capillaries.



*Figure : Exchange of Gases & Nutrient*

S.NO.	CHARACTERS	ARTERY	VEIN
1.	Direction of blood flow	Away from the heart	Towards the heart
2.	Nature of blood	Generally oxygenated	Generally deoxygenated
3.	Position	Deep seated	Superficial
4.	Nature of wall	Thicker & more elastic	Thinner & less elastic
5.	Pressure & speed of blood	At higher pressure & faster	At low pressure & slower
6.	Valves	Absent	Present

## Human Heart :

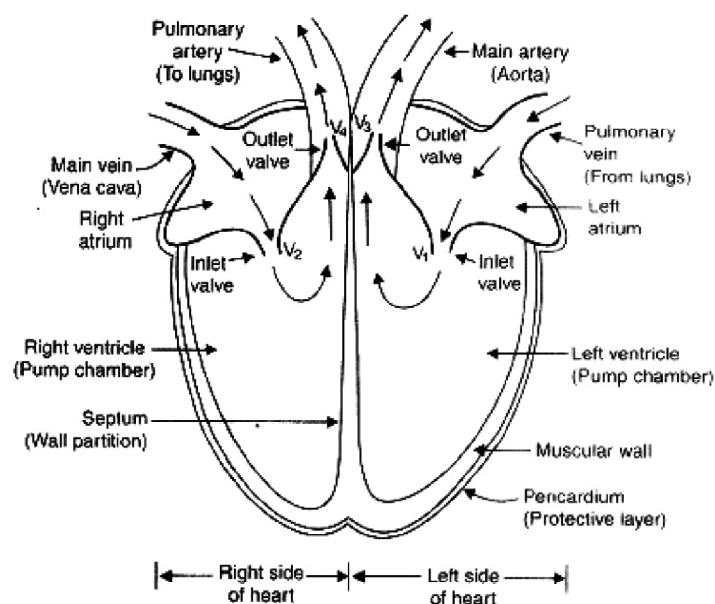


Figure. 5. Structure of Heart

- 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 or atrium 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.
- 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 in to right ventricle through tricuspid valve. A coronary sinus that drains venous blood from heart muscles. Right ventricle has semi-lunar valves for vein i.e. pulmonary vein which takes de-oxygenated blood to the lungs.
- The series of events which occur during one heart beat is called as **cardiac cycle**.

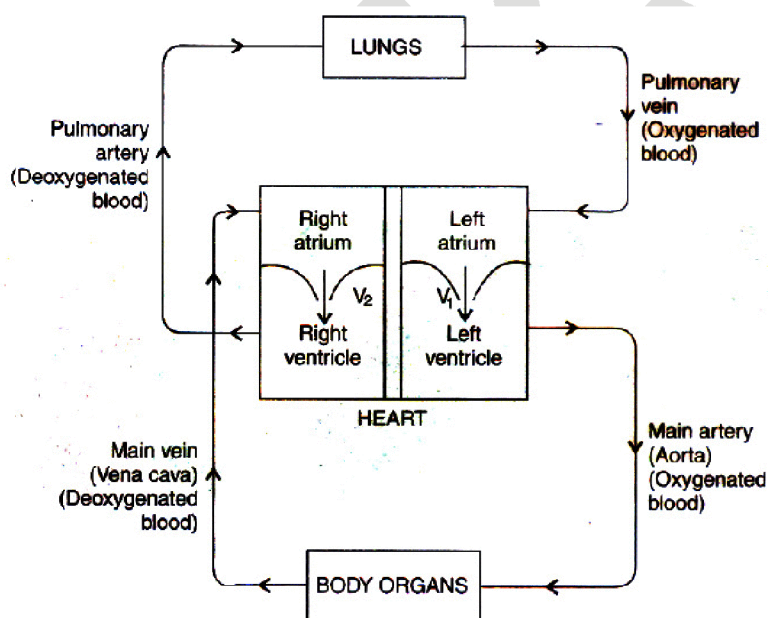
### Types of circulation :

- (1) **Single circulation** : In this, blood passes once through the heart to supply once to the body. It is found in fishes which have two chambered (one auricle and one ventricle), venous and branchial heart.
- (2) **Double circulation** : A circulatory system in which the blood travels twice through the heart in one complete cycle of the body is called double circulation.

Double circulation involves two circulations :

**Systemic circulation** : Blood completes its circulation from left ventricle to right auricle through the body organs.

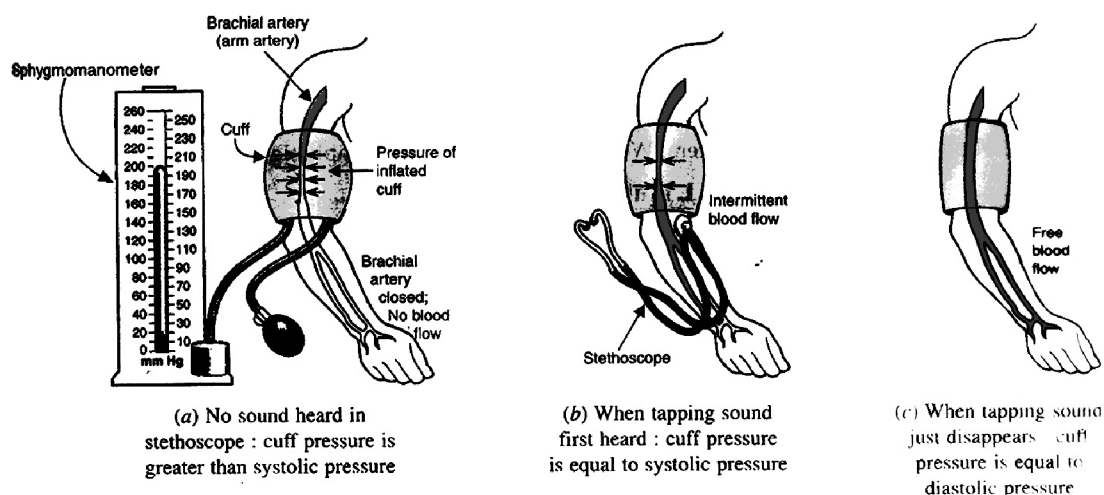
**Pulmonary circulation** : Blood completes its circulation from right ventricle to left auricle through the lungs.



*Figure : Show blood circulation in human body.*

**Blood Pressure** : Blood pressure is the pressure exerted by the blood on the wall of blood vessel in which it is present.

- 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 mm of Hg.
- The blood pressure is measured by “Sphygmomanometer”.



**Figure :** *Measuring of blood pressure by using a mercury sphygmomanometer.*

**Pulse :** Every time the heart beats, blood is forced into arteries. This blood makes the arteries expand a little. The expansion of an artery each time the blood is forced into it, is called **pulse**. Each heartbeat generates one pulse in the arteries, so the pulse rate of a person is equal to the number of heartbeats per minute. Since the heart beats about 70 to 72 times per minute, therefore, the pulse rate of an adult person while resting is 70 to 72 per minute. Thus, the pulse rate is the same as the heart rate.

#### **Abnormal conditions of blood pressure :**

**Hypertension :** It is an abnormal condition characterized by persistent high blood pressure, 150 / 90 mm of Hg. It is commonly called silent killer.

**Hypotension :** It is characterized by persistent low blood pressure, 100 / 50 mm of Hg.

#### **Detection 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.

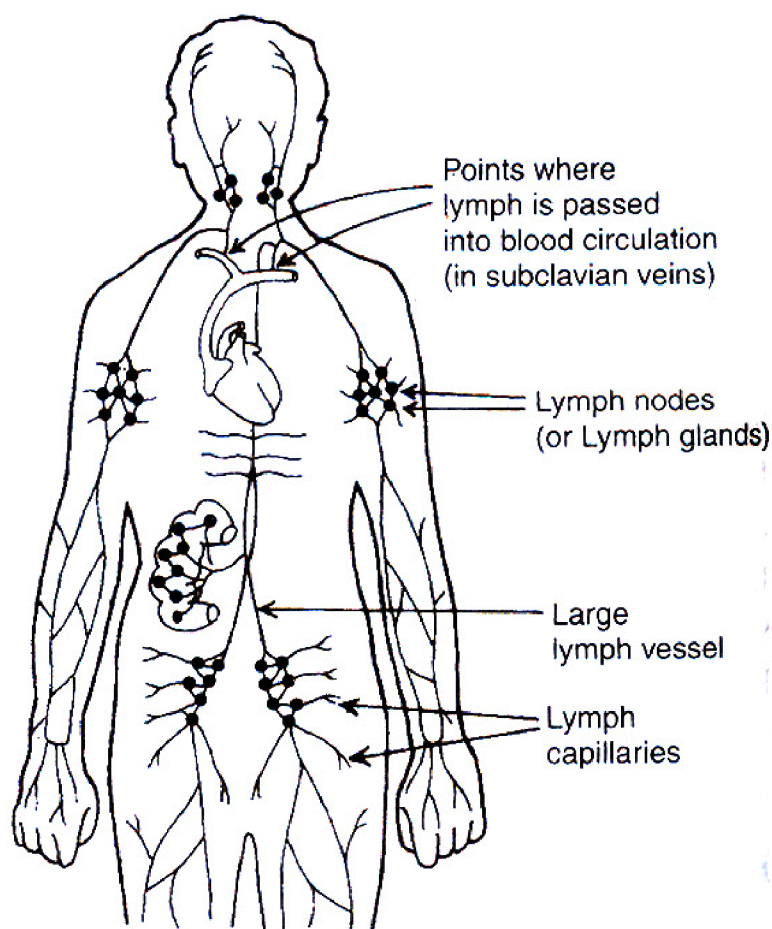
#### **(B) Lymphatic system :**

- system of tiny tubes called lymph vessels (or lymphatics) and lymph nodes (or lymph glands) in the human body which transports the liquid called lymph from the body tissues to the blood circulatory system is called lymphatic system. The lymphatic system consists of the following parts.

(a) **Lymph vessels**

(b) **Lymph nodes (or Lymph glands)**

(c) **Lymph.**



*Figure : Human lymphatic system.*

**(d) Functions of Lymph :**

- provides immunity through lymphocytes by producing antibodies.
- Fats are absorbed through lymph vessels (lacteals) in the intestine.
- It supplies digested food and oxygen to various parts of the body.
- It helps in removal of waste products like fragments of dead cells, etc.
- It returns proteins and excess tissue fluid to the blood from the tissue spaces.





## Focus Point

- Polycythemia ; V Abnormal increases in RBC count.
- Erythrocytopenia ; V Decrease in number of RBC count.
- People living in hills have more RBCs.
- Largest Leucocytes Monocytes
- Mammalian heart Myogenic
- SA node Pacemaker
- AV node Pacesetter
- Haemolysis. It is destruction of red blood corpuscles with release of haemoglobin into plasma. It results in jaundice.
- Blue Whale has the largest heart in the whole world.
- Largest vein in human body ; V Inferior vena cava.
- Largest Artery – V Aorta.
- RBCs fail to mature if there is a deficiency of vitamin B12 and folic acid.
- A “Blue baby” is the name given to an abnormal human baby who has a hole in the ventricular septum so that more oxygenated and less oxygenated blood mix.
- At higher altitude the blood volume increases.
- The spleen is often referred to as “Grave-yard” of RBCs.
- Angioplasty : A non-surgical procedure for treating diseased arteries.
- Biopsy : The procedure of taking a small tissue sample for examination.
- Cardiac arrest : The stopping of heartbeat.
- Cholesterol : A waxy substance that is produced in the human body, animal fats, and in dairy products and is transported in the blood.
- Cyanosis : Insufficient oxygen in the blood.

## EXERCISE – I

### ONLY ONE CORRECT TYPE

1. Translocation means :  
(A) Conduction of food by phloem  
(B) Conduction of food by xylem  
(C) Conduction of water by phloem  
(D) Conduction of water by xylem
2. Transpiration is helpful in -  
(A) Cooling  
(B) Loss of Water  
(C) Transportation of water & minerals in plant body  
(D) Loss of nutrients
3. A girdled tree (upto) may survive for some time but it will eventually die, because  
(A) water will not move upwards  
(B) water will not move downwards  
(C) sugars and other organic materials will not move upwards  
(D) sugars and other other organic materials will not move downwards
4. Active transport of minerals in a plant requires  
(A) a carrier protein  
(B) a supply of energy  
(C) a molecule against its concentration gradient  
(D) all of these
5. Transpiration is helpful in -  
(A) Cooling (B) Loss of Water  
(C) Ascent of sap (D) Loss of nutrients
6. Prepared food in plants is translocated by -  
(A) xylem from leaves to root  
(B) phloem from leaves to whole plant  
(C) xylem from roots to leaves  
(D) phloem from roots to whole plant
7. Bast fibre is a woody stem belongs to  
(A) cork (B) cortex  
(C) xylem (D) phloem
8. Companion cells are usually seen to be associated with  
(A) fibres tissue (B) parenchyma tissue  
(C) xylem tissue (D) sieve tissue
9. The path of water and minerals in plants during 'transpiration pull' is.  
(A) root hair → root xylem → endodermis → root cortex → stem xylem → leaf xylem  
(B) root hair → root cortex → endodermis → root xylem → stem xylem → leaf xylem  
(C) endodermis → root hair → root xylem → root cortex → stem xylem → leaf xylem.  
(D) root hair → endodermis → root xylem → root cortex → stem xylem → leaf xylem.
10. Which of the following is used in measuring blood pressure ?  
(A) Potometer (B) Sphygmomanometer  
(C) Barometer (D) Goniometer
11. An artery is a vessel that carries blood  
(A) with high concentration of oxygen  
(B) with high concentration of CO<sub>2</sub>  
(C) away from the heart  
(D) both A & C
12. Valves are found in veins to check the backflow of blood flowing under  
(A) high pressure (B) low pressure  
(C) no pressure (D) atmospheric pressure.

13. 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
14. One of the difference between blood and lymph is that  
 (A) blood has RBCs and platelets while lymph has WBCs and 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
15. Blood vessel carrying blood from lung to heart through  
 (A) Pulmonary artery (B) Pulmonary vein  
 (C) Coronary artery (D) None of these
16. Mammals are said to have double circulation, it means  
 (A) Blood vessels are paired  
 (B) There are two types of blood vessels attached to every organ  
 (C) There are two systems,  
 (D) The blood circulates twice through the heart
17. The first heart sound is produced when :  
 (A) intraventricular pressure decreases  
 (B) semilunar valve snaps shut  
 (C) bicuspid and tricuspid valve close quickly  
 (D) diastole begins
18. A transport system is needed to transport  
 (i) Nutrients, oxygen and hormones from the place, they are absorbed or received to the cells.  
 (ii) Waste products from the place they are formed to the place from where they are eliminated outside  
 (iii) Nitrogen transport from lungs to organs  
 (A) (i) and (ii) correct  
 (B) (i) and (iii) correct  
 (C) (ii) and (iii) correct  
 (D) (i), (ii) & (iii) correct
19. Pulmonary vein carries -  
 (A) impure blood always  
 (B) pure blood always  
 (C) impure blood sometimes  
 (D) mixed blood

**VERY SHORT ANSWER TYPE**

1. What is the advantage of having four chambered heart ?
2. What will happen if platelets were absent in the blood?
3. Explain the importance of transportation.
4. What is double circulation ?
5. What is lymph ?

**SHORT ANSWER TYPE**

1. Describe the functions of artery.
2. Why is blood circulation in human heart called double circulation ?
3. Differentiate between artery and vein.
4. Describe the flow of blood through the heart of human beings
5. Distinguish between transpiration and translocation.
6. Explain various components of xylem and phloem.
7. How does blood help in transportation ?
8. Explain the composition of blood. Also give functions of all it's components.
9. Distinguish between open and closed circulatory system.
10. What is 'clotting of blood' ? Write a flow chart showing major events taking place in clotting of blood.

**LONG ANSWER TYPE**

1. Why do veins have thin walls as compared to arteries ?
2. Why is transpiration important for plants ?
3. (a) Draw a sectional view of the human heart and label on it Aorta, Pulmonary arteries, Vena cava, Left ventricle.  
(b) Why is double circulation of blood necessary in human beings ?
4. Write one function each of the following components of the transport system in human beings.  
(a) Blood vessels (b) Blood platelets (c) Heart

### Answer Key

EXERCISE-I														
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
A	C	D	D	C	B	D	D	B	B	D	B	B	A	B
16	17	18	19											
D	C	A	B											

## SELF PROGRESS ASSESSMENT FRAMEWORK

(CHAPTER : TRANSPORTATION)

CONTENT	STATUS	DATE OF COMPLETION	SELF SIGNATURE
Theory			
In- Text Examples			
NCERT Exercises			
Exercise I			
Exercise II			
Short Note-1			
Revision - 1			
Revision - 2			
Revision - 3			
Remark			

### NOTES :

1. In the status, put “completed” only when you have thoroughly worked through this particular section.
2. Always remember to put down the date of completion correctly. It will help you in future at the time of revision.





*Space for Notes :*

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