REPRODUCTON

11.1 MEANING OF REPRODUCTION:

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

11.1 (a) Purpose of Reproduction :

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

11.1 (b) Basic Features of Reproduction :

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

(i) replication of DNA (ii) cell division

(iii) Formation of reproductive bodies or units (iv) development or reproductive bodies into offspring

11.2 FORMS OF REPRODUCTION :

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

11.2 (a) Asexual Reproduction :

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

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

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

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

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

(A) Binary fission : It is a type of reproduction in which nuclear division is followed by the appearance of a constriction in the cell membrane, which gradually deepens inward and divides the cytoplasm into two parts, each with one nucleus. Finally two daughter cells are formed.

e.g. Amoeba

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

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

Budding is also of two types :

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

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

NOTE : During the process of budding, the bud remains attached to the parent body so as to derive it's nutrition

from the parent but as it matures, it get's detached form the parent body.

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

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

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

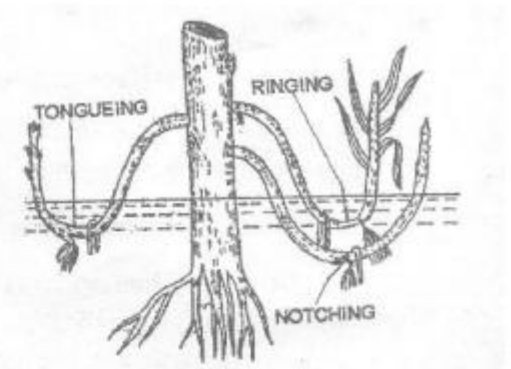
It is of following types :

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

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

It is of three types :

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



Showing vegetative propagation by layering in jasmine.

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

• **Air layering :** It is adopted in those plans where stem cannot be bent to the ground. In this process the stem is **girdled** (i.e. ring of the bark is removed). then it is covered with moist moss or cotton and wrapped with a polythene sheet to preserve the moisture. After few weeks adventitious roots develop from the injured part. The branch along with roots in then separated from the parent plant and planted to grow into a new plant. **e.g. Orange, Pomegranate** etc.

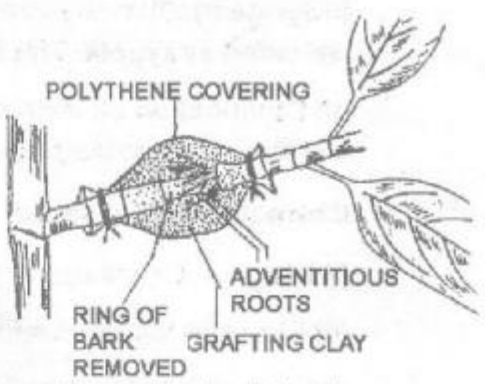


Figure : Showing Air layering.

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

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

• **Significance of vegetative propagation**

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

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

(C) Vegetative propagation is a more rapid, easier and cheaper method of multiplication of plants.

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

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

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

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

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

11.2 (b) Sexual Reproduction :

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

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

• **Types of sexual reproduction :**

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

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

• **Characteristics of sexual reproduction :**

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

(ii) It involves formation and fusion of gametes.

(iii) Cell divisions are both **meiotic & mitotic** during gamete formation and **mitotic** during development of zygote into an offspring.

(iv) The offspring's are not genetically identical to the parents.

(v) Fertilization in case of humans is internal.

(vi) Infects can be fed on mother's milk.

(vii) Parental care is very well developed,

• **Significance of sexual reproduction :**

(i) It results in multiplication and perpetuation of species.

(ii) It contributes to evolution of the species by introducing variation in a population much more rapidly than asexual reproduction.

• **General Terms :**

(i) Fertilization : It is the process of fusion of gametes.

(ii) Unisexual organism : In case of humans male and female sex organs are separate and therefore called as unisexual.

(iii) Bisexual : In plants and some organisms like tapeworm, earthworm etc. both male an female organs are present in the same individual and therefore called as bisexual.

(iv) Gonads: Organs which are involved in the formation of gametes are called as gonads.

(v) Copulation or mating : The process of transfer of male gametes into female body.

11.3 REPRODUCTION IN A FLOWERING PLANT :

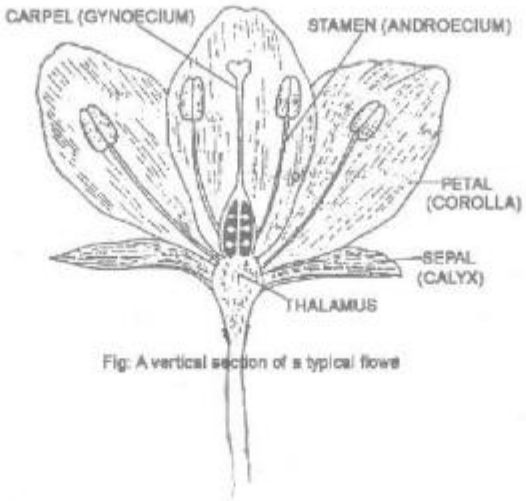


Fig: A vertical section of a typical flowe

11.3 (a)A flower Consists of Following Parts :

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

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

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

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

(B) Connective : It connects anther to filament.

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

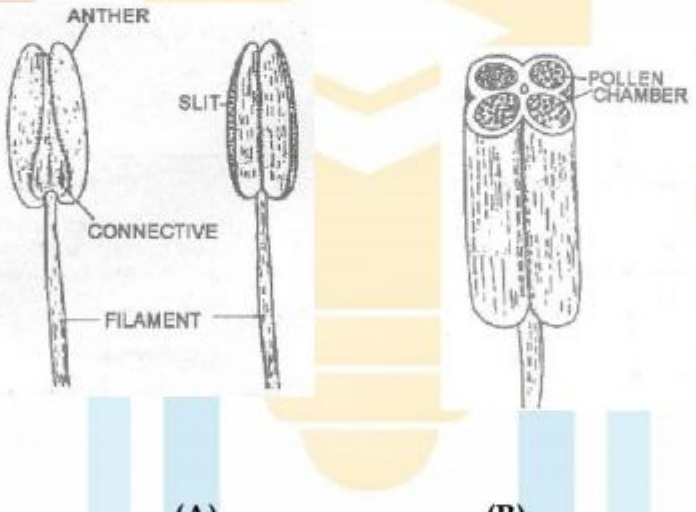


Fig. :(A) , entral view showing connective
(B) dorsal view
(C) t.s. of fanther showing pollen chambers

(vi) Gynoecium / pistil / female reproductive organ :

- It is located in the center of a flower.
- It is composed of one or more carpals.
- The freely occurring units of the carpals in a flower are called **pistils.**

- Each pistil usually consist of three distinct parts - ovary, style and stigma.

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

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

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

11.3 (b) Pollination :

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

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

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

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

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

- **Significance of self pollination :**
- It maintains purity of race.
- It also maintains the superiority of variety once developed.

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

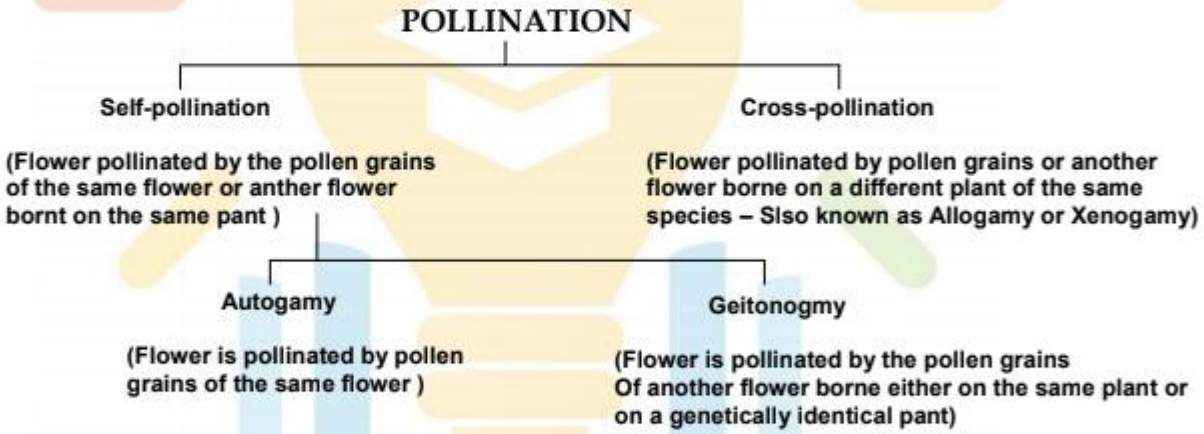


Fig : Flow diagram showing the types of pollination

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

(i) Abiotic factors	**Technical terms**
Wind	Anemophily
Water	Hydrophily

(ii) Biotic factors

Insects	Entomophily
Birds	Ornithophily
Bats	Chiropterophily
Snails	Malacophily.

- **Significance of cross pollination :**

(i) Increase in yield and adaptability.

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

(iii) It also leads to the hybrid production.

11.3 (c) Fertilization is a Flowering Plant :

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

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

- After fertilization sepals and petals fall and zygote undergoes a series of mitotic division to from a

multinuclear embryo.

- At maturity wall of ovules changes to **seed coat** of which outer one is hard and is known as **testa,** while inner one is called as **tegnum.**

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

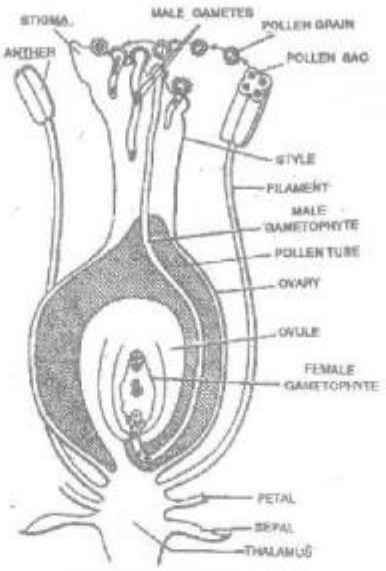


FIG: SHOWING FERTILIZATION IN A FLOWER

DIFFERENCES BETWEEN SELF POLLINATION AND CROSS POLLINATION		
S.NO.	**SELF POLLINATION**	**CROSS POLLINATION**
1.	Pollen grains are transferred from the anther to the stigma of the same flower (autogamy) or another flower on the same plant (geitonogamy)	Pollen grains are transferred from the anther of one flower to the stigma of another flower borne on a different plant of the same species (allogamy).
2.	Both the anther and stigma mature at the same time.	The anther and stigma of a flower generally mature at different times.
3.	It can occur even when the flowers are closed	It occurs only when the flowers are open.
4.	External agent is not required for self-pollination.	An external agent abiotic or biotic, is essential for cross-pollination
5.	It is economical for the plant.	Cross-pollination is not economical at the plant has to produce a lot of pollen grains, nectar, scent and bright-coloured corollas etc.
6.	Self-pollination ultimately results in progenies which are pure lines i.e. homozygous.	Cross-pollination produces the offspring which as hybrids i.e., heterozygous. They show variations in characteristics.
7.	In cannot eliminate useless or harmful characters.	It can eliminate useless or harmful characters.
8.	Highly useful characters get preserved in the race.	Useful characters cannot be preserved in the progenies.
9.	Self-pollination does not introduce any variations and hence the offspring are unable to	Cross-pollination introduce variations in the offsprings. These variations make these plants to adapt

	adapt to the changed environment.	better to the changed environment for the struggle for existence.
10.	Immunity of the race towards disease falls in the succeeding progenies.	Immunity of the race towards disease is usually marinated in the succeeding progenies.
11.	Yield of the plant gradually falls with time.	Yield of the plant usually does not fall.
12.	Self-pollination never helps in the production of new varieties and species.	Cross-pollination is a mechanism of roducing new varieties and species among plants.

DAILY PRACTIVE PROBLEMS # 11

OBJECTIVE QUESTIONS

1. Cleistogamous condition is present in

(A) Brassica oleracea (B) Solanum tuberosum (C) Arachis hypogea

(D) Allium cepa

2. Which of the following regenerated with the help of layering?

(A) Cactus (B) Rose (C) Mango (D) Jasmine

3. Development of egg without fertilization is

(A) parthenocarpy (B) polyembryo

(C) parthenogenesis (D) adventive embryony

4. Anemophily is pollination by

(A) air (B) water (C) insects (D) animal

5. Pollination between different flowers of same plant is called

(A) autogamy (B) geitonogamy (C) allogamy (D) xenogamy

6. Double fertilization is

(A) fusion of two male gametes with egg

(B) fusion of one male gamete with egg and the other male gamete with the polar bodies

(C) both are correct

(D) both are incorrect

7. The structure meant for the nourishment of developing embryo in case of plant is

(A) pollen tube (B) endosperm

(C) both A & B are correct (D) none of these

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

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

9. The genetic information is stored in -

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

10. Each female flower consist of

(A) ovary (B) stigma

(C) ovary, style and stigma (D) thalamus

SUBJECTIVE QUESTIONS

VERY SHORT ANSWER TYPE QUESTIONS

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

LONG ANSWER TYPE QUESTIONS

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

REPRODUCTION

BL-12

12.1 SEXUAL REPRODUCTION IN HUMANS :

- Mammals are unisexual.
- Reproductive system of each organism consists of many reproductive organs.
- These can be primary sex organs or secondary sex organs.
- The **primary sex organs** are called as **gonads.** They produce sex cells or **gametes** and also secrete sex hormones.
- The gonads of males are called a **testis,** which produce **sperms.**
- The gonads of females are called as **ovaries,** which produce **ova or female gametes.**
- **Secondary sex organs** include the reproductive ducts which transport gametes and reproductive glands which help in process of reproduction. These organs do not produce gametes.
- **e.g., In males :** Vasa efferentia, epididymis, seminal vesicles, ejaculatory duct, urethra etc. **In females :** Fallopian tube, uterus, vagina, mammary glands etc.
- **Accessory or external sec characters** help to distinguish the two sexes of a species externally.
- **e.g., In male :** Muscular body, more height, low pitched voice, moustaches etc.

  In female : High pitched voice, breast development, lateral pubic hairs etc.
- **Puberty :** Beginning of sexual maturity is known as **puberty.**
- At this stage primary sex organs start functioning.

- Secondary sex organs develop dully under the influence of sex hormones produced by primary sex organs.
- In the stage of puberty body growth is very rapid.
- It occurs at the age of **10 - 14 years in girls** and **13 - 15 years in boys.**

12.1 (a) Male Reproductive System :

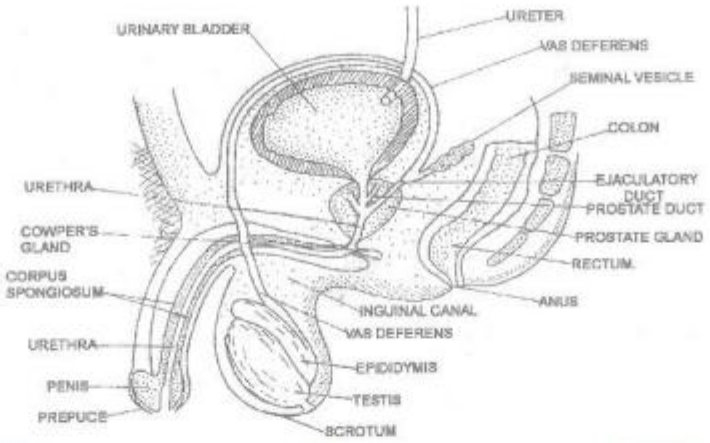


Fig : Male reproductive system.

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

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

(i) Testis :

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

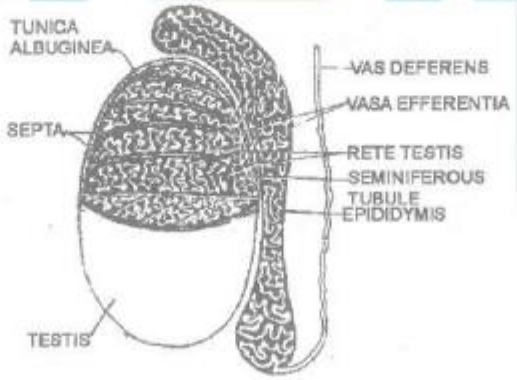


Fig : Longitudinal section of mammalian testis .

• It also consist of convoluted somniferous tubules.

• These somniferous tubules at one end join to form tubules which open into a network of irregular cavities known as **rete testis.**

• This rete testis comes out from a dorsal surface of the testis with the help of **vesa efferentia.**

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

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

• Epididymis peon into a narrow tube **vas deferens.**

• **Somniferous tubules** from the spermatogenic tissue of the testis.

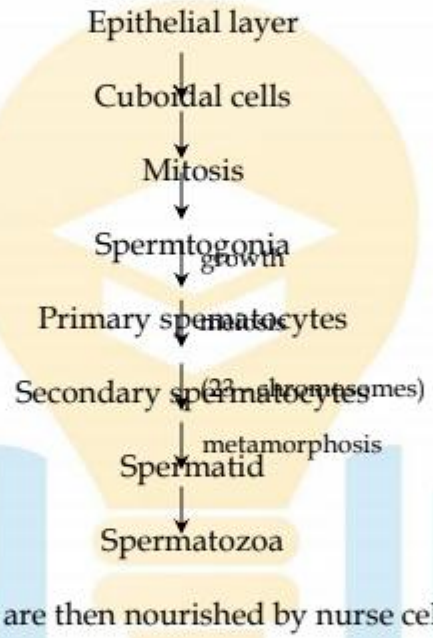
• It consists of a germinal epithelial layer at the periphery. Spermatogenesis occurs at the center.

• It forms spermatogonia which grows and form spermatocytes which further grow to form **primary spematrocytes,** which undergo meiosis to form **secondary spermatocytes** and then **spematids.**

• The later (i.e. spermatids) metamorphose into **spermatozoa.**

• This process of formation of spermatozoa from spermatogonia is called as **spermatogenesis.**

• These spermatozoa are nourished during the development by nurse cells.



Flow chart showing the process of Spermatogenesis

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

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

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

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

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

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

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

• **Duct system :**

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

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

(v) Vas deference :

- Vasa efferentia from epididymal duct finally opens into vas deferens.
- It comes out through inguinal canal passing over urinary bladder to receive ducts from seminal vesicles.
- They are thick walled and muscular and conduct sperms.

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

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

(vii) Accessory glands: They consist of prostrate gland, a pair of seminal vesicles, and a pair of cowper's gland.

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

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

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

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

12.1 (b) Semen :

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

- It's quantity is 2.5 - 4.0 ml at a time having about 40 million sperms.
- Semen has chemical for nourishment of sperms neutralizing the acidity of urethra and vagina, stimulating their movement in female tract.
- **Spermatogenesis** starts at puberty under the influence of **gonadotropin** secreted from **anterior pituitary gland.**

12.1 (c) Structure of Sperm :

Each sperm consists of following parts :

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

(i) Head : It is oval in structure. It is composed of a large nucleus and a small **acrosome.** The nucleus is compact. It consists of DNA and basic proteins. Acrosome lies at the tip of nucleus. It is formed of golgi complex. It consist of hydrolytic enzymes and is used to contact and penetrate the egg during fertilization.

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

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

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

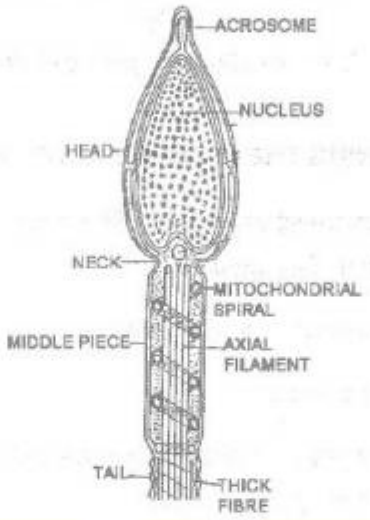


Fig : Mammalian spam

12.2 FEMALE REPRODUCTIVE SYSTEM :

Female reproductive system comprises of following parts :

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

(iv) Vagina (v) Glands

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

- Ovary is covered by two layers outer is made up of **germinal epithelial cells.**
- Inner layer is called as **tunica albuginea** which is made up of **fibrous connective tissues.**
- The ovary consists of inner part called as **stroma.**
- It's outer peripheral pat is called as **cortex** while inner part is called a **medulla.**

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

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

The developing oocyte is called as primary oocyte

↓

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

↓

It later on forms follicular layer

↓

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

↓

This stage is called as secondary follicle

↓

This is called as graffian follicle

FLOW CHART SHOWING THE FORMATION OF GRAFFIAN FOLLICLE

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

• The cells of corpus luteum secrete the hormones

(A) progesterone during pregnancy. **(B)** Relaxing at the end of pregnancy.

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

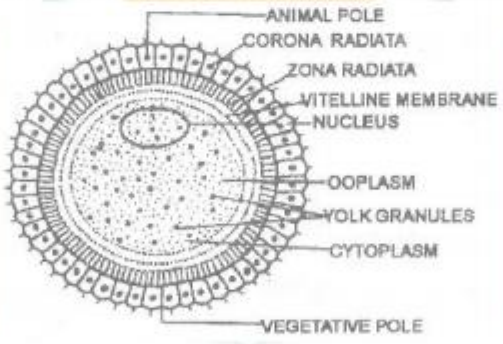


Fig : structure of ovum .

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

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

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

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

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

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

- It is situated in a **pelvic cavity.**
- It is attached to the fallopian tube from the sides and below it opens into vagina through **cervix.**
- This uterus undergoes cyclic changes during phases of menstrual cycle.

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

(v) Vagina : It is a large, median, elastic, muscular tube. This canal opens externally into **labia minora** and **labia majora.** It's folds consist of stratified squamous epithelium which has mucous lining It secretes a lubricant fluid. **Labia majora** is the innermost, thin, moist fold. **Labia minora** is outer large and hair covered. pH of vagina is 4.3 It is also called a **"Birth canal".**

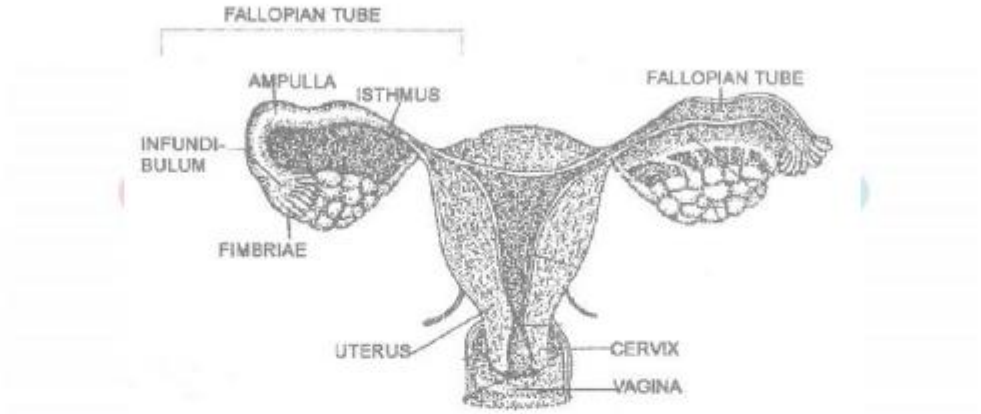


Fig : Female reproductive system.

(vi) Gland :

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

12.2 (a) menstrual Cycle :

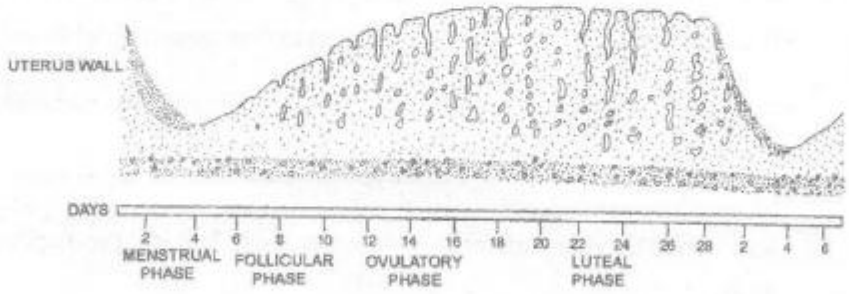


FIG : SHOWING VARIOUS PHASES OF MENSTRUAL CYCLE

- It is a cyclic phase of the flow of blood with mucus and tissues etc. from the uterus of a woman at monthly interval.
- It occurs on average of 28 days interval.
- It starts at the age of 12-14 years and stops at 45-50 years of life.

- This cycle stops during pregnancy.
- The menstrual cycle consists of following phases :

(i) Bleeding or menstrual phase :

- It is the first stage of menstrual cycle.
- It's duration is of 5 days but normally bleeding is found for 2-3 days.

• In this stage hormones **estrogen, progesterone, follicle stimulating hormone** and **luteinizing hormone** are found in minimum quantity.

• Total 100 ml, of blood flows in a complete bleeding phase.

(ii) Proliferative phase :

• In this phase F.S.H. stimulate development and maturation of graffian follicles.

• In this phase oestrogen level rises which leads to formation of new endometrium.

• It lasts for about 10 - 14 days. Thinnest endometrium is found in this phase.

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

(iii) Ovulation phase :

• At this phase ovulation occurs.

• Ovulation occurs in the presence of FSH and LH.

• Thicket endometrium found in this stage.

• It also lasts for about 14 days.

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

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

• If, fertilization does not take place, this stage completes on 28th day of menstrual cycle.

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

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

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

12.2 (b) Ooganesis :

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

Ovum consists of two types of coverings :

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

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

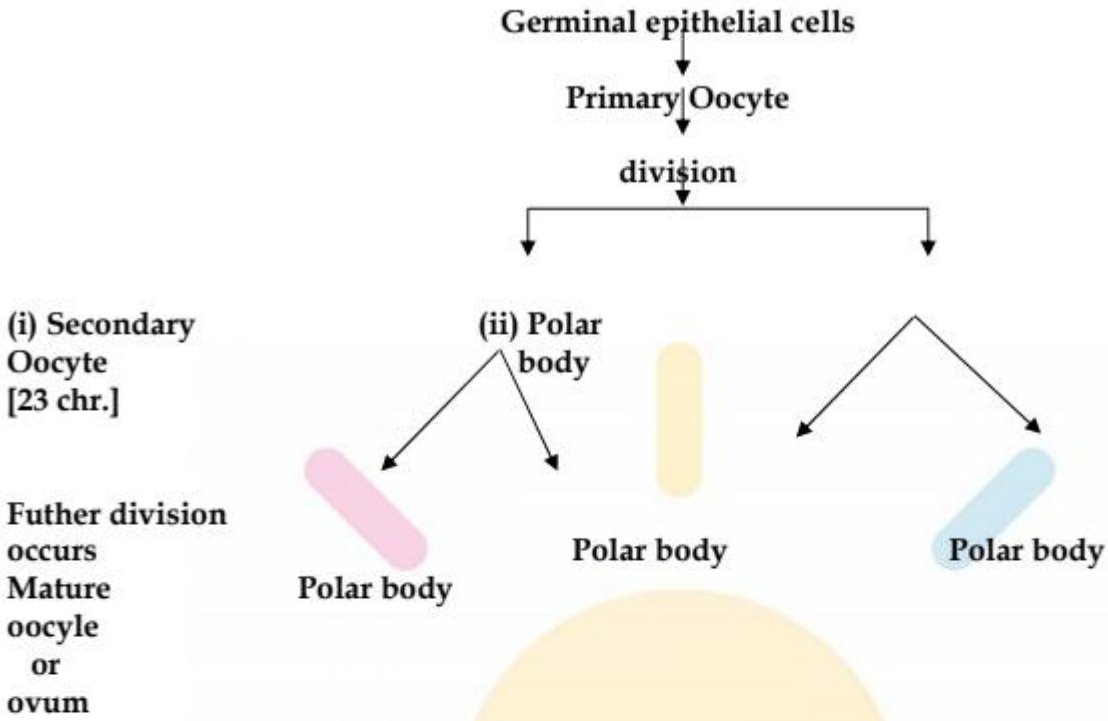
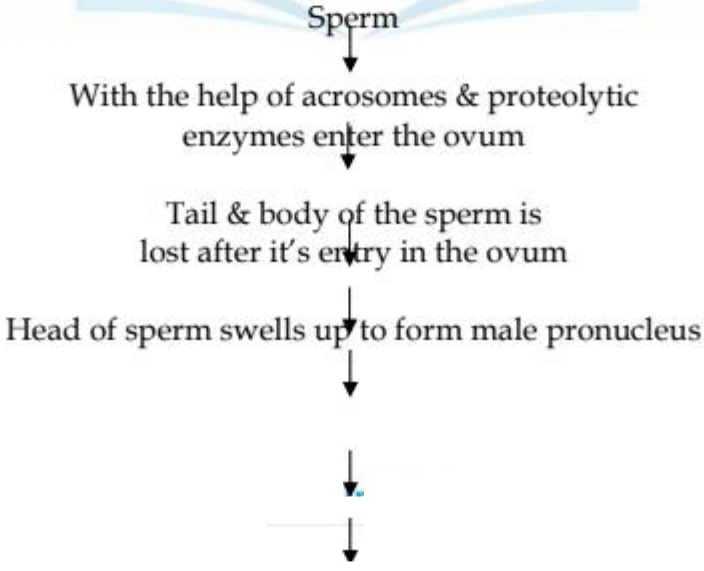


FIG : THE PROCESS OF OOGENESIS

12.3 FERTILIZATION :

- It included release of ovum from the ovary, where it remains viable for 12 - 24 hours.
- At the time of sexual intercourse the sperm enters in to the vagina.
- Only one sperm is required for fertilization of the ovum.
- The head of the sperm penetrates the corona radiate layer of ovum and then the **zona pellucida** layer.
- This process if facilitated by acrosome and proteolytic enzymes.
- After penetration the tail and body of the sperm is lost, only head remains inside the ovum.
- It's head begins to swell and forms **male pronucleus.**
- Here the pronuclei of sperm and ovum fuse to from a new resultant nucleus each contributing 23 chromosome, so that the resultant may have 46 chromosomes.



This male pronucleus fuses with female pronucleus

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

Zygote

Embryo

Fig : Showing process of fertilization

- Fusion of male & female gametes is called as **fertilization.** Zygote starts developing in fallopian tube

and forms embryo, this later on moves to uterus. It gets attached to uterine walls and the whole process is called as **implantation**

- Placental formation occurs between uterine wall and the foetus, which provides nourishment to the foetus.
- The time period for which a developing fetus remains inside the mother's womb is called as **gestation period.** it extends for about 9 months or 40 weeks or 280 days.
- The process of giving birth to baby is called as **parturition.**

12.4 ARTIFICIAL INSEMINATION :

- It is a technique to make a female pregnant by artificially introduction semen into vagina.
- In this process semen from a good quality male is collected, preserved by freezing and used when required.
- In case of humans it is also being used for improving the chances of fertility.
- A man may be infertile due to insufficient number of sperms, weak or premature ejaculation, inability of penis to undergo and enter the vagina or nonmotile sperms.
- In this case husband's semen is collected, concentrated and introduced artificially into the wife's vagina. this is called as **artificial insemination.**
- If the husband's sperms are faulty, some donors sperm can be used. This is called as **artificial insemination donor.**
- **Artificial insemination has following two advantages.**

(i) Semen of good quality male animal is used to inseminate a number of females.
(ii) Preserved semen can be transported to distant places, excluding the need for sending the male animal there.

Differences between asexual and sexual reproduction	
Asexual reproduction	Sexual reproduction
1. It is always unipraental	It is generally bipraental.
2. Gametes are not formed.	Gamete are formed
3. There is no fertilization.	Fertilization occurs in it.
4. In involves mitotic cell division.	It involves meiotic cell division.
5. Daughter individual are genetically identical to the parent	Daughter individual are different from theparents.

6. It does not contribut to the evolution.	It contributes to the evolution by introduction variation in the offspring

12.5 POPULATION GROWTH:

- The term population refers to the total number of individuals of a species occupying particular geographical area at a given time.

- The scientific study of human population is called as **"demography".**
- **Factors that lead to increase in population are :**

(i) Increase in protection from risk (ii) Illiteracy

(iii) Desire of son (iv) Decline in death rate

(v) Desire for more earning hands

(vi) Unawareness of various birth control measures

12.6 METHODS ADOPTED FOR POPULATION CONTROL

(i) Planned control of population :

(A) By educating people about the advantages of small family.

(B) Raising the age of marriage can help in reducing population growth.

(C) By family planning.

(ii) Temporary methods :

(A) Safe period : A week before and after the menstrual cycle is considered to be infertile and fertilization, does not occur during this period.

(B) Coitus interrupts : It involves withdrawal by males before ejaculation so that semen is not deposited, in vagina.

(C) Chemical means : These includes certain jellies, paste, foam tables which when introduced into vagina cause immobilization of sperms and kill them. They also include contraceptive pills which inhibit secretion of F.S.H. and L.H. ovulation is inhibited.

(D) Mechanical means :

- They involve use of condoms.
- Use of cervical or diaphragm cap which is fitted in the vagina that checks the entry of sperms.
- **IUD (intrauterine device)** called as **copper-T** is also fitted in the uterus which prevents fertilization.

(E) Surgical methods: It involves **tubectomy** in females which involves cutting of fallopian tube, and **vasectomy** in males which involves cutting of vas deference from both the sides. However,

surgical removal of ovaries also occurs which is called as **ovariectomy** and in males removal of testis called as **castration.**

- **Abortion :** Medical termination of pregnancy is called as **abortion.**

DAILY PRACTIVE PROBLEMS # 12

OBJECTIVE QUESTIONS

1. In mammals, the testes lies in scrotal sacs due to

(A) presence of urinary bladder (B) presence of rectum

(C) long vas-deference (D) requirement of low temperate for spermatogenesis

2. Graffian follicles are found in

(A) testis of mammas (B) ovary of frog (C) ovary of cockroach (D) ovary of mammals

3. Site of fertilization in mammals is

(A) ovary (B) uterus (C) vagina (D) fallopian tube

4. The process of reproduction which involves only a single parent to form an individual

(A) sexual reproduction (B) asexual reproduction

(C) none of these (D) Both A & B are correct

5. Cowper's glands are found in

(A) male mammals (B) female mammals (C) male amphibians (D) female amphibians

6. Loss of reproductive capacity in women after age of 45 years is

(A) menstruation (B) ageing (C) menopause (D) menarche

7. Release of oocytes from ovary is

(A) gestation (B) ovulation (C) parturition (D) implantation

8. Acrosome is made up of

(A) mitochondria (B) centrioles (C) golgi bodies (D) ribosomes

9. Acrosome aids the sperm to

(A) penetrate vitelline membrane of ovum (B) find ovum

(C) swim (D) higher activity

10. Progesterone is secreted by

(A) corpus luteum (B) thyroid (C) thymus (D) testis

SUBJECTIVE QUESTIONS

SHORT ANSWER TYPE QUESTIONS

1. Why regeneration is considered to be a method of reproduction ?
2. When an organism is called as bisexual, what does it indicate ?
3. Define fertilization.
4. What happens to the ovule and the ovary after fertilization?
5. Define the term puberty.

LONG ANSWER TYPE QUESTIONS

6. What is name the sexual cycle in human females called ? Explain the sexual cycle in human female.
7. What do you understand by gestation period and what is it's time duration ?
8. In case of self-pollination there are two possibilities. State them.
9. What is the function of fallopian tube ?
10. What is semen ?

ANSWER

DAILY PRACTIVE PROBLEMS # 11

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

DAILY PRACTIVE PROBLEMS # 12

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

HEREDITY & INHERITANCE

BL-13

13.1 HEREDITY :

In includes those traits or characters which are transmitted from generation to generation and are therefore fixed for a particular individual.

- **Genetics :** Study of Heredity and variation is said to be known as **genetics.** The term genetics was first of all used by **W. Bateson** in 1905. An Austrian monk namely **Gregor Johann Mendel** was the first person to study genetics. He was therefore regarded at the **'Father of Genetics'.**

13.2 VARIATIONS :

Variation is concerned with the difference between the individuals of same species and also between the offspring of the same parents.

- **Variations could be of two types :**

(i) Somatic variation **(ii) Germinal variation**

(i) Somatic variation : Somatic variation affects the somatic cells of an organism. It is neither inherited from parents nor transmitted to next generation. It is acquired by individual during it's own life and is lost with it's death. It is therefore also called a **acquired variation** or **blastogenic variation.**

- **Somatic variations are due to :**

(A) Environment : This includes the factors that affect the organisms such as food, air, pressure, humidity, after etc. Environment affects all the organisms however they also affect the plants because they cannot move or hide themselves.

- **Light :** Strong sunlight affects the human skin by increasing the dark pigment melanin in the epidermal cells. Melanin protects the underlying cells by absorbing the ultra violet rays of the sun. Plants grown in shade become weak and pale and acquire long internodes and broad leaves.
- **Habitat :** It also affects the genetic make - up of an individual and leads to variations.
- **Nutrition :** It is also one of the various factors that cause variations.

(B) Use of disuse of organs : Continuous use of an organ makes it better developed whereas constant disuse makes it reduced.

(C) Conscious efforts : Conscious efforts by man produce somatic variations in humans themselves, in domestic animals and plants.

(ii) Germinal variation : This variation affects the germ cells of an organism and is consequently inheritable. It is received by the individual from the parents and is transmitted to the next generation.

- **Germinal variation could be of two types :**

(A) Continuous variations : [Fluctuating variations] The continuous variations are very common in nature. These are found in all animals and plants and affect all of their organs. These various are unstable and do not contribute to the formation of new species.

- **Causes of continuous variations :**
- New combination of character
- Crossing over [recombination of genes]

(B) Discontinuous variations : This variation refers to large conspicuous differences of the offspring from the parents. This variation is also known as **mutation** and the individual with this kind of variation is called as **mutant. This** is not common in nature. It appears suddenly. It is stable and inheritable.

- **Causes of discontinuous variations :**
- Modification in structure of chromosomes.
- Alteration in the chemical nature of genes.
- Change in the number of chromosomes.
- Radiations and chemicals may also cause mutation.
- **Significance of Variation :**
- Variation enables the organisms to adapt themselves to the changing environment.
- If forms raw material for evolution.
- It enables the organisms to face the struggle for existence in a better way.
- It helps men in improving the races of useful animals and plants.
- It is the basis of heredity.
- It also leads to the existence of new traits.

13.3 HEREDITY AND VARIATION IN ASEQUAL REPRODUCTION :

There are organisms in which reproduction occurs by asexual means. These include Bacteria, Amoeba, Euglenas, fungi etc. many plants such as rose and sugarcane, lower animals namely Hydra, planaria etc.

This asexual reproduction is monoparental and the organism produced by it inherits all the traits of it's single parent. It is almost a carbon copy of the parent and is known as it's **clone.** It is also called as **clonal reproduction. Here**, one thing to the noted is the term **'offspring'** is not used in case of asexual reproduction.

- **The clones may develop variations :**
- By environmental factors
- By mutation

The variations causes due to environmental factors are not transferable but these variations which are caused by mutation are stable and inheritable.

13.4 HEREDITY AND VARIATIONS IN SEXUAL REPRODUCTION :

Variation is very much common in animals and plants which carry reproduction by sexual means. The reason for this is the sexual reproduction is biparental and the offspring receives some traits from one parent and some traits from other parent. Interbreeding of closely related individuals reduces the occurrence of variations in the offspring's produced by the sexual reproduction.

13.4 (A) Earlier Views of Heredity :

Different theories have been put forward to explain in what physical form the traits pass from the parents to the offspring's.

(i) Vapour theory: This theory was proposed by a **Greek Philosopher Pythagoras.** he states that each organ of an animal body emitted some kind of water vapour and that a new individual was formed by the combination of these vapours from different organs.

(ii) Fluid theory : Another **Greek Philosopher Aristotle** [384 - 322 B.C.] stated that

(A) Man's semen is highly purified blood.

(B) Woman's menstrual fluid is the female semen, which was not as pure as man's semen.

(C) The two combines during intercourse and female semen provides substance for embryo formation and male semen provides from and vitality to embryo. This is called as **Blending theory of inheritance.**

(iii) Preformation theory : This theory was proposed by **Anton Von Leeuwenhoek** who was the first to observe human sperm. He called them **"animalcules".** He states that each sperm has a potential to develop into a new individual when introduced into the woman's womb where it could get nourishment. This theory was rejected because it failed to explain the inheritance of maternal characters by offsprings.

(iv) Particulate theory : A French biologist Maupertius proposed that each animal produces minutes particles for reproduction and a new individual is formed by the union of the particles of the two parents. Then a famous **English Naturalist Charles Darwin** forwarded the theory of **pangenesis** for the inheritance of characters. He assumed that tiny particles called **pangenes** or **gemmules** by his were formed in the various parts of the body and migrate to the reproductive cells and hence to the offsprings to guide the formation of the respective parts. Thus the young one has a blend (mixture) of the pangenes hence here is a presence of the characters of both the parents.

Mendel was the first to give the **particulate theory of heredity.** He had experimented on pea plants to study how traits are transferred or inherited. He unfortunately failed to explain the cause of inheritance. He also proposed various principles to explain the inheritance. Later on other scientists led to the discovery of genes and chromosomes.

13.5 MENDEL'S EXPERIMENTS AND LAWS OF INHERITANCE :

Gregor Johann Mendel is appropriately called as **Father of genetics.** With the help of his experiments on garden pea, he was able to formulate laws which explain the manner of inheritance of characters. Although Mendel described his **results in 1866,** his work was recognized only in 1900, when Mendel's laws were rediscovered simultaneously y **Hugo de varies a Dutch biologist, Carl Correns a German botanist** and **Erich von Tschermak as Austrian botanist.**

- **Some general terms used by him are :**
- **Dominant trait :** The trait which appears in F_1 generation is called as dominant trait. It is denoted by capital letter. **e.g. TT (tall).**
- **Recessive trait :** The traits which does not appear in F_1 generation is called as recessive trait. It is denoted by small letter, **e.g. tt (dwarf)**
- **Monohybrid cross :** It involves the study of inheritance of one pair of contrasting character. **e.g.** Inheritance of tall and dwarf characters.
- **Dihybrid Cross :** It is the inheritance of two pairs of contrasting characters.
- **Trihybrid cross :** it is the inheritance of three pairs of contrasting characters.

- **Back cross :** The cross between F_1 generation with any of the parents is known as **back cross.**
- **Test cross :** The cross between F_1 generation and the recessive parent is called as **test cross.**
- **Genotype :** It is the genetic representation of a trait. **e.g. TT** or **Tt for a tall plant.**
- **Reciprocal cross :** The reciprocal cross involves two crosses concerning the same characteristic but with reverse sex. It means if in the first cross A is female and B is male then in the second cross A will be male and B will be female.
- **Phenotype :** it is the expression of a trait **e.g. Tall pea plant,** it can be noted by direct observation of an individual.
- **Allele :** Term allele refers to each of the members of a genetic pair.
- **Homozygous traits :** They have similar alleles for specific trait (TT or tt). They produce only one type of gametes.
- **Heterozygous traits :** They have dissimilar alleles for a specific trait (Tt). They produce two types of gametes

13.6 MENDEL'S EXPERIMENT

Mendel chose garden pea as plant material for his experiments, since it has following advantages.

- Well defined characters
- Bisexual flowers
- Predominantly self-fertilization
- Easy hybridization
- Cross fertilization is possible

13.6 (a) Crossing Technique Employed by Mendel :

Since garden pea is self- fertilizing, the anthers have to be removed before maturity. This operation is called as **emasculation.** The stigma is protected against any foreign pollen with the help of a bag. The pollens then at the dehiscence stage, is brought from the plant to be used as male parent and is dusted on the feathery stigma of the emasculated flower. At the time of pollination, the pollens should be **mature** and the stigma should be **receptive.**

Emasculation
↓
Bagging [for protection]
↓
Dehiscence [by dusting pollens]
↓
Pollination

(i) Traits choosen by Mendel for his experiment : There are seven traits which Mendel has choosen, they are as follows :

S.No.	Characters	Dominant	Recessive
1.	Stem height	Tall	Dwarf
2.	Flower colour	Violet	White
3.	Flower position	Axial	Terminal
4.	Pod shape	Inflated	Constricted
5.	Pod colour	Green	Yellow
6.	Seed shape	Round	Wrinkled
7.	Seed colour	Yellow	Green

(ii) Mendel performed experiments in three stages :

(A) he made sure that, the plant which he had choosen must be true breeding plant, by letting the plant to undergo self-fertilization.

(B) He performed the process of cross palliation of alternate forms of traits. The resultant generation obtained was termed as hybrid, and these hybrids formed are called as **F_1 generation i.e. First filial generation.**

(C) He allowed the hybrid to self pollinate upto five generations and these generations are subsequently termed as F_2, F_3, F_4 and so on.

(iii) Result's of Mendel's Experiments :

(A) When the self pollination was made and F_1 generation was obtained, it was found that the resultant generation would express only one of the trait and not the other. The trait which is being expressed is called as **dominant,** whereas the one which is not expressed is called as **recessive** trait.

(B) In the F_1 generation obtained by self p

ollination, the dominant and the recessive traits obtained were in the ratio of **3 : 1** i.e. 75% of the offsprings which appeared in F_2 generation had dominant trait, while 25% had recessive trait. This ratio of 3 : 1 is also said to be known as **Mendelian monohybrid**

ratio .

	T	T
t	Tt	Tt
t	Tt	tt

In F_1 all are tall
(F_1 × F_1)

	T	t
T	TT	Tt
t	Tt	Tt

In F_2 we will get 3 : 1 ratio.

TT → Homozyous Tall
Tt → Heterozyous tall } Tall [3]
Tt → Heterozyous tall

tt → Homozygous dwarf] dwarf [1]

Homozygous tall : Heterozygous tall : Homozygous dwarf

1 : 2 : 1

(C) Mendel further found that the phenotypic ratio of 3 : 1 of dominant to recessive form of a trait was actually a genotypic ratio of **1 : 2 : 1 of pure dominant, hybrid and pure recessive forms.** The traits which remain hidden in F_1 generation got expressed in F_2 generation. This was later on proved in F_3 generation.

(iii) Reasons from Mendel's success :

(A) He selected true breeding [pure] pea plant for his experiment.

(B) He studies single trait at time.

(C) He kept an accurate mathematical record of his breeding experiments and noted down the number of each type of offspring produced in each cross.

(D) He was lucky enough to select the seen traits, as the gene for these traits are located on four different chromosomes.

13.7 MENDEL'S LAWS OF INHERITANCE :

On the basis of the experiments performed and the result obtained Mendel formulated four laws. They are :

13.7 (a) The Principle of Paired Factors :

Each character in a n individual is governed by two factors called as **gene.** The alternative form of gene is called as **alleles** or **allelomorphs.** If an individual consists of similar types of **alleles,** they are called as **homozygous e.g.** TT, tt while those having different types of alleles are called as **heterozygous e.g. Tt** etc.

13.7 (b) The Principle of Dominance or Law of Dominance :

When two homozygous individuals with one or more sets of contrasting character are crossed the characters that appear in the F_1 hybrids are dominant characters and those which do not appear in F_1 are recessive characters.

13.7 (c) The Principle of Segregation of Law of Segregation :

[Law of purity of gametes] The law of segregation states that when a pair of contrasting factors or genes or allels are brought together in a heterozygous condition, the two remains together without being contaminated but when gametes are formed form them the two separate out from each other. This is also known as **Mendel's first law of heredity.**

13.7 (d) The Principle of Independent Assortment or Law of Independed Assortment:

If the inheritance of more than one pair of characters is studied simultaneously, the factors or genes for each pair of characters assort out independently. It is called as **Mendels second law of heredity.**

13.8 DIHYBRID CROSS :

In dihybrid cross Mendel crossed genetically pure yellow round seeded (YYRR) pea plant with green wrinkled (yyrr) pea plant. All the plants of F_1 were all yellow and round seeded (YyRr).

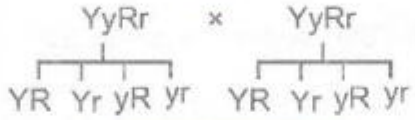
In F_2 generation four types of plants appeared as :

- Yellow rounded - 9
- Yellow wrinkled - 3
- Green round-3
- Green wrinkled - 1

So here phenotypic ratio is 9 : 3 : 3 : 1

	yr	yr
YR	YyRr	YyRr
YR	YyRr	YyRr

All F_1 plants are yellow and round seeded



	YR	Yr	yR	yr
YR	YYRR	Yyrr	YyRR	YyRr
Yr	YYRr	Yyrr	YyRr	Yyrr
yR	YyRR	YyRr	yyRR	yyRr
yr	YyRr	Yyrr	yyRr	yyrr

13.9 GENES :

The term **'gene'** was introduced by **Johansson** for Mendelian factor. Gene determines the physical as well as physiological characteristics. They are transmitted from parents to their offsprings generation after generation. Genes are located on chromosomes where they occupy specific position called as **locus. This** was proved experimentally by **T.Bovery** and **W.S. Sutton** in 1902. They are responsible for characteristic features.

13.9 (a) Molecular Structure of Gene :

Chemically gene is formed of DNA. If consists of following parts :

(i) Recon : It is the smallest unit of DNA capable of undergoing crossing over and recombination.

(ii) Muton : It is also the smallest unit of DNA capable of undergoing mutation.

(iii) Cistron : It is a gene is real sense, which consists of number of **nucleotides** and which is capable of

synthesizing a polypeptide chain of enzymes.

(iv) Replicon : It is a unit of replication.

DAILY PRACTIVE PROBLEMS # 13

OBJECTIVE QUESTIONS

1. When a red flower homozygous pea plant is crossed with a white flower plant what colour is produced in F_1 ?

(A) Red (B) White (C) Pink (D) Red and white

2. Mendel formulated the law of purity of gametes on the basis of

(A) dihybrid cross (B) monohybrid cross (C) back cross (D) test cross

3. A cross between AaBB X aa BB yields a genotypic ratio of

(A) 1 AaBB : 1 aaBB (B) 1 AaBB : 3 aaBB (C) 3AaBB : 1 aa BB (C) All AaBb

4. In monohybrid cross what is the ratio of homozygous dominant and homozygous recessive individual in F_2 - generation ?

(A) 1 : 2 : 1 (B) 2 : 1 / 1 : 2 (C) 3 : 1 / 1 : 3 (D) 1 : 1

5. Back cross is a cross between

(A) $F_1 \times F_1$ (B) $F_1 \times$ Recessive (C) $F_1 \times$ Dominant (D) $F_1 \times$ any parent

6. A white flowered mirabilis plant rr was crossed with a red coloured RR, if 120 plants are produced in F_2 generation. The result would be

(A) 90 uniformly coloured and 30 white (B) 90 Non - uniformly coloured and 30 white

(C) 60 Non-uniformly coloured and 60 white (D) All coloured and No white

7. Which one caries extra nuclear genetic material ?

(A) Plastids (B) Ribosomes (C) Chromosomes (D) Golgi - complex

8. The ratio of phenotype in F_2 generation of a dihybrid cross is

(A) 3 : 1 (B) 1 : 2 : 1 (C) 2 : 1 (D) 9 : 3 : 3 : 1

9. Branch of biology deal s with heredity and variation is called

(A) Palaentology (B) Evolution (C) Genetics (D) Ecology

10. The factors which represent the contrasting pairs of characters are called

(A) Dominant (B) Recessive (C) Determinants (D) Alleles

SUBJECTIVE QUESTIONS

SHORT ANSWERT YPE QUESTIONS

1. What are autosomes ?

2. Name the four nitrogen bases of a nucleotide.

3. Define the term genetics.

LONG ANSWER TYPE QUESTIONS

4. What does the science of genetics deals with ?
5. Differentiate between submetacentric and metacentric chromosomes with diagram.
6. Explain the structure of a gene.
7. What is genetic engineering ?
8. Why did Mendel choose pea (Pisum sativum) for his experiment ?

BL-14

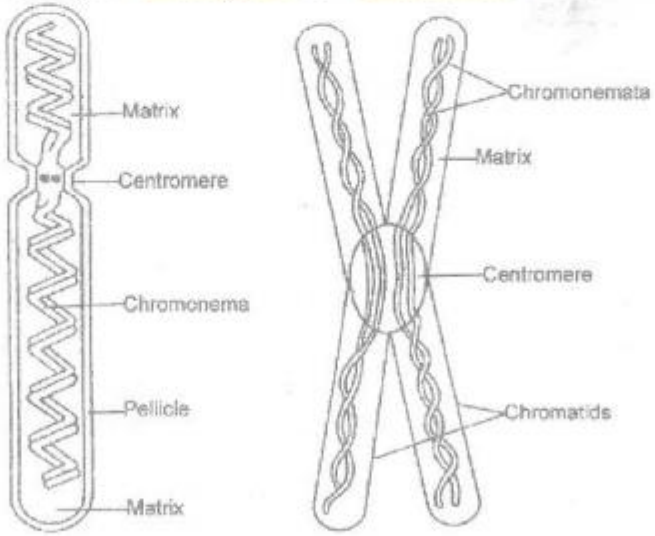
14.1 CHROMOSOMES :

E.Strasburger discovered chromosomes in 1875. They are thread like structure and are called as chromosomes due to their affinity towards **dyes [chroma = colour]. Genes** are located on chromosomes and the genetic material of chromosomes is DNA. These are also called as **"hereditary vehicles "** as they are capable to transmit hereditary material to the next generation.

- **Chromosomal theory of Inheritance: Sutton and Boveri** Proposed this theory in 1902. This theory consists of following salient features :
- Somatic cells are diploid in number i.e. these consist of two sets of chromosomes, one set from the mother and other set from the father.
- The chromosomes retain their structural uniqueness, identity and continuity.
- The paired condition of chromosomes is resorted during fertilization.
- The behavior of chromosomes during meiosis at the time of gamete formation provides an evidence that genes are located on chromosomes. This also explain the mechanism of segregation of characteristic at the time of gamete formation.

14.1 (a) Structure of chromosomes :

Each chromosome consists of two strands which are called as **chromatids.** The two chromatids of a chromosome are joined together at a point called as **centromere.**



(a) Structure of chromosome (b) Metaphase chromosome.

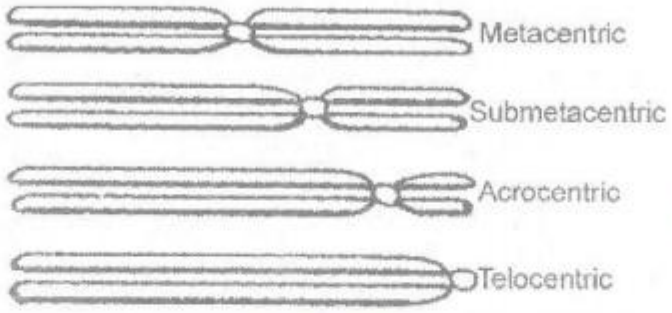
- Depending on the position of centromere a chromosome can be of different types and attain different shapes during anaphase. They are :

(i) **Metacentric :** They are V - shaped. These have centromere in the middle of chromosome so that the two arms are almost equal.

(ii) **Sub metacentric :** They are L shaped. In this centromere is slightly away from the mid point, so that the two arms are unequal.

(iii) **Acrocentric :** They are J-shaped with centromere at subterminal position.

(iv) **Telocentric :** They are rod shaped, having terminal centromere.



Types of chromosomes.

14.1 (b) Size and Shape of Chromosomes :

Size of chromosomes greatly very during cell cycle.

(i) **Interphase :** It forms long thread like structure called as **chromatin.**

(ii) **Metaphase :** Chromosomes are thickest and shorted and therefore have definite shape and size. At this stage chromosomes can be counted easily.

(iii) **Anaphase :** They have rod like J-shaped or V- shaped structures during this phase.

(iv) **Telophase :** They have thread like structure.

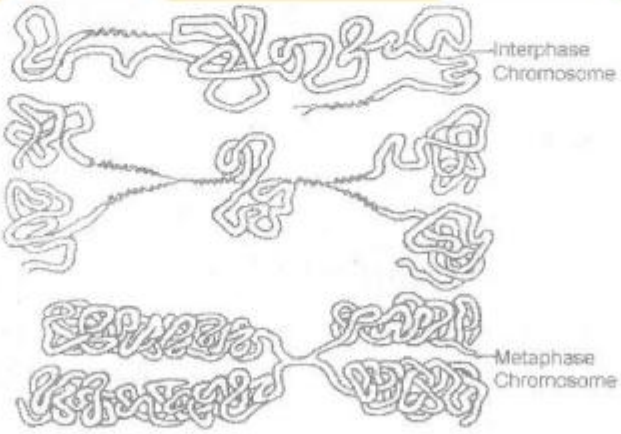


Fig : To show condensation of chromatin network.

14.1 (c) Number of Chromosomes :

Each species has a fixed number of chromosomes in it's cells. In case of human beings, there are 46 number of chromosomes in each body cell. 46 chromosomes in an ordinary human cell are of

23 different types. So, there are two chromosomes, of each kind. The two chromosomes of each kind are called as homologous chromosomes. A cell which has the full number of chromosomes with two of each kind is called as diploid cell. In other words a diploid cell has two sets of each type chromosomes. The gametes (or sex cells) of human being are different from their other body cells because they contain only half the number of chromosomes.

A cell which has half the number of chromosomes, with one of each kind, is called as haploid cell. In other words a haploid cell has only one set of each type of chromosomes **e.g. sperm** and **eggs** have only 23 chromosomes each, which is half the number of chromosomes of other body cells. So, the gamete is a

haploid cell. Females consists of two similar gametes and therefore called as homogametic and males consist of dissimilar gametes and therefore called as heterogametic. The term homomorphism and heteromorphy are also used for females and males respectively. During spermatogenesis two types of sperm cells will be produced one which contains X chromosome and the other which contains Y chromosome. During oogenesis each egg will produce two X chromosomes. If X-chromosome of male fuses with X-chromosome of female it will produce a female child. If Y-chromosome of male fuses with X-chromosome of female it will produce a male child.

14.1 (d) Properties of Chromosomes :

The chromosomes must poses five important properties :

(i) **Replication :** Synthesis of new DNA molecule which is identical to the parent DNA molecule.

(ii) **Transcription :** Synthesis of RNA molecule from DNA molecule.

(iii) Change in appearance.

(iv) **Repair :** It means repair of damaged parts of DNA.

(v) **Mutation :** Development of genetic changes.

14.1 (e) Functions of Chromosomes :

(i) They carry hereditary characters from parents to offsprings.

(ii) They help the cell to grow, divide and maintain itself by synthesis of proteins.

(iii) They undergo mutation and thus contributed to the evolution of animals.

(iv) They guide cell differentiation during development.

(v) They also help in metabolic processes.

(vi) They bring about continuity of life.

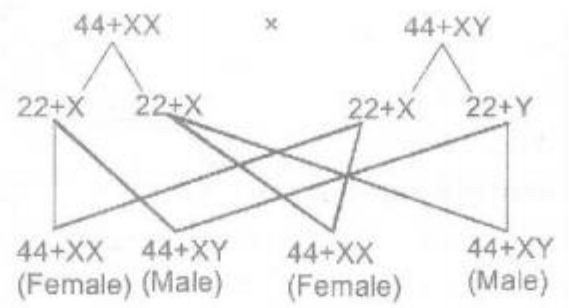
14.2 SEX DETERMINATION :

- **Chromosomes are of two types :**
- **Autosomes or Somatic chromosomes :** These regulate somatic characters.
- **Allosomes or Heterosomes or Sex chromosomes :** These chromosomes are associated with sex determination. Sex chromosomes were first discovered by **"Mc Clung"** in grasshopper. X chromosome was discovered by **Henking.**

14.2 (a) X X - XY Type or Laygaues Type :

This type of sex determination is first observed by **Wilson** and Stevens in **Laygaeus insect.** It is of two types :

(i) **X X female and XY male :** In this type of sex determination female is **homogametic** while males is **heterogametic e.g. Humans**


44+XX
×
44+XY
22+X
22+X
22+X
22+Y
44+XX
(Female)
44+XY
(Male)
44+XX
(Female)
44+XY
(Male)

(ii) XY female and XX male : In this type of sex determination female is **heterogametic** while males is

homogametic. e.g. Butter flies, moth and vertebrates like birds, fishes and reptiles.

14.2 (b) XX Female and XO Male or Pronetor Type :

sIn this type of sex determination there is a deficiency of one chromosome in male. In this type female is homogametic and male is heterogametic. **e.g. Grasshopper and Cockroach**

14.3 GENETIC ENGINEERING :

In recent years, techniques for manipulation of prokaryotic as well as eukaryotic DNA have witnessed a remarkable development. This has allowed breakage of a DNA molecule at two desired places to isolate a specific DNA segment and than insert it in another DNA molecule at the desired position. The product thus obtained is called as **recombinant DNA** and the process is called as **"genetic engineering".**

14.3 (a) Tools of Genetic Engineering :

The various biological tools used in the synthesis of recombinant DNA are :

(i) Enzymes (ii) Vehicle or vector DNA

(i) Enzymes :

(A) Lysing enzyme : These are used to open up the cells to get DNA for genetic experiment.

Lysozyme is commonly used to dissolve the bacterial cell wall.

(B) Cleaving enzymes : These are used to break DNA molecule. Three types of cleaving enzymes are known. They are :

- **Exonuclease :** Which cut off nucleotides from 5′ or 3′ ends of DNA molecules.
- **Endonuclease :** Which cleaves the DNA duplex at any point except ends.
- **Restriction endonucleases :** Restriction endounucleases are the enzymes which recognize specific nucleotide sequence and cut the DNA molecules. Restriction endonuclease was discovered by **Arber** in **Eschrichia coli. Nathans (USA), Smith, Arber** won the Noble prize for **Physiology and Medicine** in 1978 for the discovery of restriction endounuclease.

(C) Synthesizing enzymes : These play an important role in the synthesis of DNA strands on suitable templates. They are of two types :

- **Reverse transcriptase :** These help in the synthesis of complimentary DNA strands on RNA templates.
- **DNA polymerase :** This helps in the synthesis of complimentary DNA strands on DNA templates.

(D) Joining enzymes : These help in sealing gaps in DNA fragment which are joined by complimentary base pairing **e.g. T_4 - ligase.**

(E) Alkaline phosphatase : These cut off phosphate groups from free ends of linearized vehicle DNA to prevent recircularization.

(ii) Vehicle or vector DNA : The DNA used as carrier for transferring a fragment of foreign DNA into a suitable host called as vehicle DNA. **e.g. Plasmid and Bacteriophage DNA.**

14.3 (b) Application of Genetic Engineering :

(i) It is applied for modification of plant colours.

(ii) It helps in cloning of transgenic plants.

(iii) It can be proved beneficial in case of plants **e.g. "nif"** gene is transferred in plants which is responsible for N_2 fixation.

(iv) It is used for curing various genetic disorders.

(v) It can be proved beneficial for synthesis of insulin growth, hormone etc.

(vi) It can be used to delay ripening of fruits.

14.4 DNA : (DEOXYRIBOSE NUCLEIC ACID)

DNA was first isolated by **Frederick Meischer** from the nucleus of **pus cells** and called as **nuclin. Watson and Crick** gave the double helix model of DNA. They also won a noble prize for it. Chromosomes consist of nucleoprotein which are made up of nuclei acid and proteins.

14.4 (a) Composition of DNA :

DNA molecule consists of following three components :

(i) Deoxyribose sugar **(ii)** Phosphate group

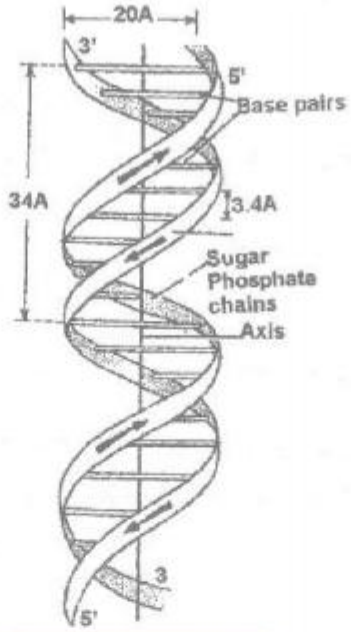
(iii) Nitrogen bases : They could be **purines or pyrimidines.**

(A) Purines are : Adenine [A] and Guanine [G]

(B) Pyrimidines are : Thymine [T] and Cytosine [C]

- One DNA molecule consists of a u nit called **nucleotide.**
- Nucleotide = nucleoside + phosphate
- Nucleoside = nitrogen base + deoxyribose sugar

14.4 (b) Structure of DNA :



Structure of a DNA molecule

(i) It consists of two helical polypeptide chins which are coiled around each other.

(ii) Both the chains are antiparallel to each other.

(iii) Both chains have complementary base pairing i.e. A = T and G≡C.

(iv) The two strands are held together, by hydrogen bonds.

(v) The diameter of a DNA molecule is 20 Å.

(vi) One helix consists of about 10 bp.

(vii) It's helicle length is 34 Å and the distance between two nearest base pairs is 3.4Å.

(viii) It also consists of major and minor grooves.

(ix) Each strands consists of a backbone made up of alternating deoxyribose sugar and phosphate, they are joined by **phosphodiester bonds.**

14.5 SOME IMPORTANT TERMS :

- **Karyotype :** In includes the details of the number of chromosomes of an organism, their size and shape. It is better achieved in metaphase stage.
- **Idiotype :** It is a diagrammatic representation of a karyotype.

- **Banding technique :** For the purpose of identification chromosomes a special staining technique is sued. It is called as **banding technique.**
- In the process of genetic engineering the gene that is transferred into an organism is called as **transgene.** An organism that contains and express a transgene is called as **transgenic organism or generically modified organism [GMO].**

- Hirudin is a protein that prevents blood clotting. The gene encoding hirudin is chemically synthesized. This is then transferred to Brassica napus, where hirudin is accumulated in seeds. It is then purified and used as medicine.
- A soil bacterium **Bacillus thuringenesis,** produces a crystal **"cry"** protein. This protein is toxic to the larvae of certain insects. There are various types of cry protein each resistant to specific type of insect.
- Viral chromosomes consist of proteins and one nucleic acid i.e. DNA or RNA. Nucleic acid may be single or double stranded, may be circular or linear. Virus with RNA as genetic material is called as **retrovirus e.g. HIV** [Human Immuno Deficiency Virus]
- **Replication :** DNA is the only molecule capable of self duplication so it is termed as "living molecule". All living beings have the capacity to reproduce because of this chrematistic of DNA. DNA replicates in the "S" phase of cell cycle. In the process of replication a new DNA is synthesized in the form of strands.
- **These strands are of two types :**

(i) **Leading strands :** Formation of new strands always takes place in 5′ - 3′ direction. It is a continuous strand.

(ii) **Lagging strand :** it is formed as small fragments known as **okazaki fragments. These** fragments are later on joined by **ligase enzymes.**

DAILY PRACTIVE PROBLEMS # 14

OBJECTIVE QUESTIONS

1. The main aim of plant breeding is

(A) to produce improved varieties (B) to make soil fertile

(C) to control pollution (D) to become more progressive

2. Plants having similar genotypes produced by plant breeding are called

(A) clone (B) haploid (C) autopolyploid (D) genome

3. Two allelic genes are located on

(A) the same chromosome (B) two homologous chromosomes

(C) two non-homologus chromosomes (D) any two chromosomes

4. Mendel's law of segregation is based on separation of allels during

(A) gamete formation (B) seed formation (C) pollination (D) embryonic development

5. What is the effect of sexual reproduction ?

(A) Offspring is weak (B) Offspring is like the parent

(C) Offspring is more vigorous (D) Offspring is diseased

6. Disease resistant varieties can be produced by

(A) crossing a plant with wild variety (B) treating with colchicine

(C) crossing with hormones (D) treating with low temperature

7. Heterozygous tall plants were crossed with dwarf plants, what will be the ratio of dwarf plants in the progeny

(A) 50% (B) 25% (C) 75% (D) 100%

8. A pure tall plant can be differentiated from a hybrid tall plant

(A) by measuring length of plant

(B) by spraying gibberellins

(C) if all plants are tall after self-pollination

(D) if all plants are dwarf after self-pollination

9. Allel is the

(A) alternate trait of a gene pair (B) total number of genes for a trait

(C) total number of chromosomes of haploid set (D) total number of genes present a chromosome

10. In animals sex determination is due to

(A) X-chromosome (B) Y - chromosome (C) A - chromosome (D) B - chromosome

SUBJECTIVE QUESTIONS

SHORT ANSWER TYPE QUESTIONS

1. What is karyotype ?
2. What is meant by chromosomes ?
3. Who is known as the father of genetics ?
4. What determines the functional property of a gene ?
5. What was transgenic organisms ?

LONG ANSWER TYPE QUETIONS

6. What does the law of segregation states ?
7. What do you understand by the term nucleoside and nucleotide ?
8. How it was established that genes are located on chromosomes ?

9. Explain the importance of variations.
10. Explain the law of dominance.

ANSWERS

DAILY PRACTIVE PROBLEMS # 13

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

DAILY PRACTICE PROBLEMS # 14

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

OUR ENVIRONMENT

BL - 15

15.1 ECOSYSTEM :

- The term Ecosystem was coined by **Tansley.** According to him Ecosystem is a symbol of structure and function of nature.
- The term Ecology was coined by **Reiter.**
- The term Ecology was first of all described y **E.Haeckel.**
- Father of India Ecology - Prof. **Ramdas Mishra.**

***8** The boundaries of ecosystem are indistinct and have an overlapping character with each other.

- "The total group of living things and environment of factors present in a particular place is called as ecosystem/"
- It means any structural and functional unit of the environment that can be identified and studied is called as ecosystem.
- Ecosystem may be natural or artificial, permanent or temporary. Large ecosystem is called as **biome** such as desert, forest etc.
- **Homeostasis :** Self maintainable characteristic is found in ecosystem. It means an ecosystem maintains the balance between the different trophic levels. Each trophic level controls the other trophic level in an ecosystem.
- **Cybernetics :** A science of self control [homeostasis] in an ecosystem is called as **"cybernetics"**

15.1 (a) Types of Ecosystem :

Natural (e.g. lake, forest, grassland etc.) or man made (e.g. an aquarium crop field etc.)

(i) **Temporary** : **e.g.** rain-fed pond etc.

(ii) **Permanent** : **e.g.** lake, forest etc.

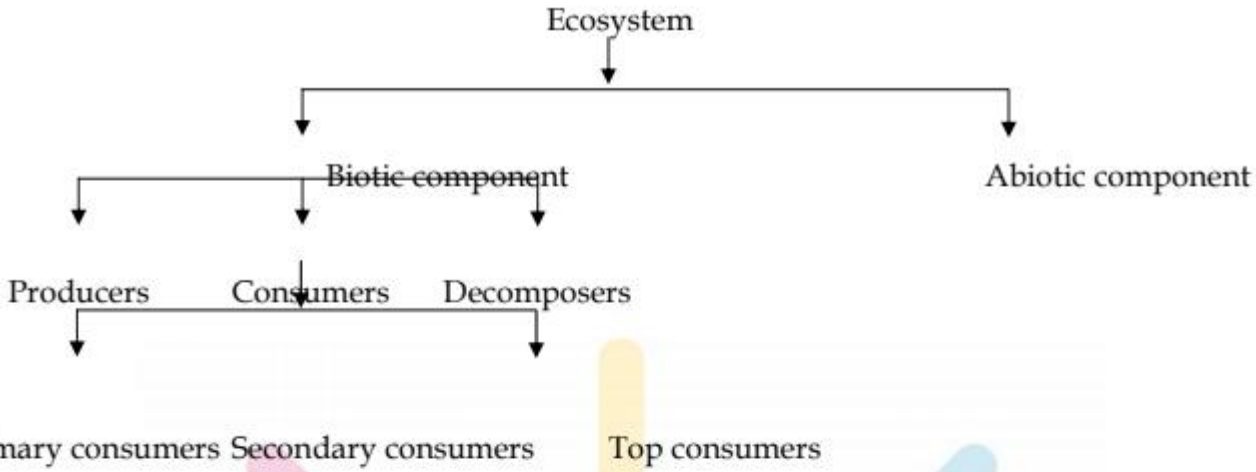
- An ecosystem may be as small as a drop of pond water. Such small ecosystem is called as micro ecosystem. Human activities may modify or convert natural ecosystem into man made ecosystem. Cutting tree or forests and the conversion of land for tree plantation or agriculture etc. are some of the examples of conversion of natural ecosystem to man made ecosystem.

15.1 (b) Components of Ecosystem :

Ecosystem consists of two components :

(i) Biotic component **(ii)** Abiotic component (environment, soil etc.

(i) **Biotic components :** Different biotic components are connected, through food chain or other relations. That is why it is said that all the living organisms comes under biotic components. Food available for biotic components can be synthesized, from inorganic raw material by the autrophs only.



- Biotic components are of thee types which are essential for ecosystem.

(A) Producers : All the autotrophs of ecosystem are called as producers. The green plants are the main producers. Green plants absorb solar energy and convert it into chemical energy. It means energy enters into the ecosystem through the produces. The solar energy is the only ultimate source of energy in ecosystem. This energy is available to the remaining living organisms through the medium of food.

(B) Consumers: All the heterotrophy of the ecosystem are known as consumers. Animals are the main consumers. They directly (herbivorous) or indirectly (carnivorous) depend upon the producers. There are various types of consumer which are as follows :

- **Primary consumers :** They are also known as secondary producers because they synthesize complex materials in the cells by the digestion of food which they obtain from the plants. Such living organisms which obtain food form the producers are known as primary consumers. Such as all the herbivores of ecosystem.
- **Secondary consumers :** Animals which feed upon primary consumers and obtain their food. It means those carnivorous which kill and eat the herbivorous. So that they are called as predators **e.g.** Dog, Cat, Snake etc. In aquatic system whale fish is a secondary consumer.
- **Top consumers :** Those animals which kill other animals and earth them by they are not eaten by other animals in the nature **.e.g** Lion, Vulture, Peacock and Man (human) in our ecosystem. Man and peacock may be omnivorous.

(C) Decomposers or Microconsumer : Those living organisms which decompose the dead bodies of producers and consumers and release mineral substances again into the soil which are present in the dead bodies. So that decomposers help in mineral into the soil which are present in the dead bodies. So that decomposers help in mineral cycle. Only because of this land is the main source of minerals. The main decomposers in ecosystem are - bacteria and fungi which decompose continuously dead animals and dead plants.

(D) Scavengers : Vulture never kills any animal so that vulture is a scavenger, not a decomposer. The process of decomposition takes place outside the body of bacteria. The break down of the food materials takes place in the body of vulture and minerals are released into the

soil in the form faecal material. They are also called as reducers because they decomposes and remove the dead bodies of the organism.

15.1 (c) Structure of an Ecosystem :

The structure of an ecosystem is characterized by the physical organization of biotic & abiotic components. The major structural features of an ecosystem are species composition, stratification, trophic organization and nutrients.

(i) Species composition : Each ecosystem has its own type of species composition. Different ecosystems have different species composition. A great variety of species is found in forest ecosystem, whereas a few species occur in a desert ecosystem.

(ii) Stratification : The organisms in each ecosystem from one or more layers or strata, each comprising the population of particular kind of a species.

(iii) Trophic organization : Food relationship of producers and consumers is another way to predict ecosystem structure. In an ecosystem there an be only 4 - 5 successive trophic levels because

(A) All the food available in one tropic level is not being eaten by another animal in the next trophic level.

(B) All the food eaten by an animal is not useful, thus a part of energy containing food is passed out as

waste products.

(C) A large amount of energy is lost in respiration to drive organisms metabolism and thus, there is not much energy left to support higher trophic levels.

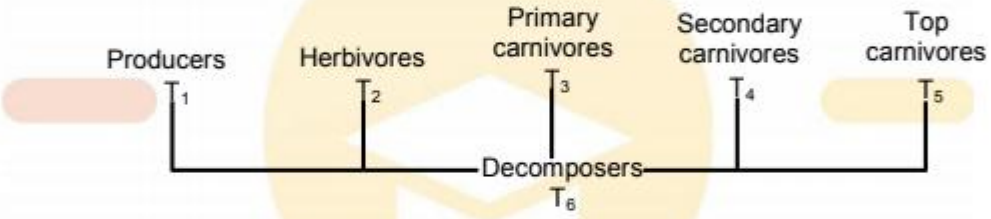


Fig : Trophic levels in Ecosystem

• The amount of nutrients such as nitrogen, phosphorus and calcium present in the oil at any given time is termed as standing state.

15.1 (d) Functions of an Ecosystem :

(i) Productivity : Ecosystem helps of maintain the productivity, of the system. The rate of organic matter or biomass production is called as productivity. The study of biomass production in the ecosystem is called as production ecology.

(ii) Energy flow : Energy flow in an ecosystem is a key function of an ecosystem. It determines the following two laws of Thermodynamics :

(A) First law : It states, that energy can neither be created nor destroyed, but can be transferred from one from to other.

(B) Second law : It states, that every energy change involves the degradation or dissipation of energy,

from concentrated to the dispersed form due to metabolic functions, so that only a small part of energy is stored in the biomass.

(iii) Nutrient cycles : All living organisms get matter from the biosphere component i.e. lithosphere, hydrosphere and atmosphere. Essential elements or inorganic substances are provided by earth and are required by organisms for their body building and metabolism, they are known as biogeochemical or biogenetic nutrients.

(iv) Development and stabilization : This function is necessary for the development and giving stability to various life form's by undergoing certain modifications.

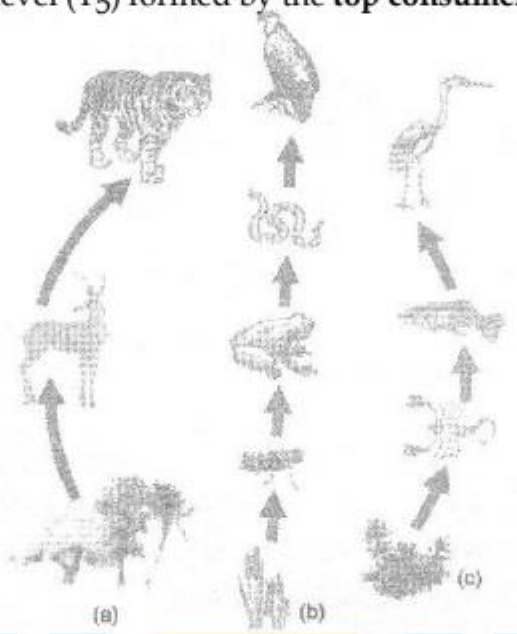
15.2 FOOD CHAIN :

- The chain of organisms which involves transfer of energy from one trophic level to next trophic level is called as food chain.

- The flow of food or energy is an ecosystem is called **Food chain.** Those organisms which join with the food chain are termed as **Trophic levels.**
- Usually, there are four trophic levels present in the ecosystem because level of energy decreases during the flow of energy from one trophic level to the another trophic level.

First trophic level [T_1]	:	Producers
Second trophic level [T_2]	:	Primary consumers
Third trophic level [T_3]	:	Secondary consumers
Fourth trophic level [T_4]	:	Top consumers

- The flow of energy occurs in an ecosystem from the first trophic level to the fourth trophic level in the food chain. These are five trophic levels also found in a highly complex ecosystem in which tertiary consumers are present in between the secondary consumer and top consumers, then fifth trophic level (T_5) formed by the **top consumers.**



Food chain in nature (a) in forest , (b) in grassland & (c) in a pond

15.2 (a) Types of food Chain :

There are three types of food chains which are found in nature.

(i) Predator food chain (ii) Parasitic food chain (iii) Saprophytic food chain

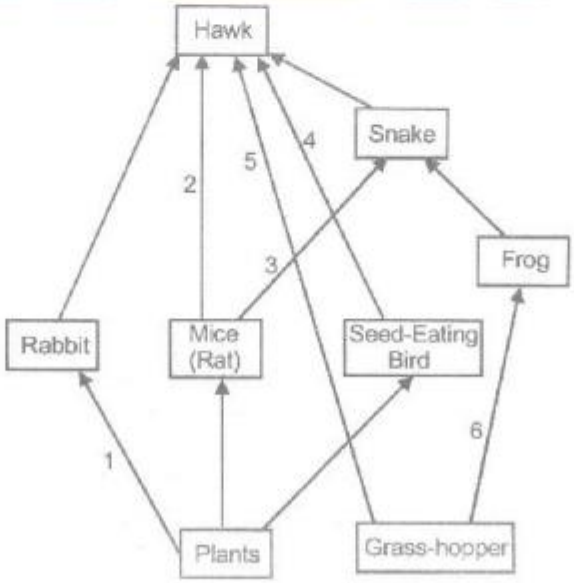
- Predator food chain extends from producers through herbivores to carnivores, parasitic food chain stat from producers but ends with parasites and saprophytic food chain starts with decomposers. Producers are autotrophic organisms which synthesize organic food from simple inorganic raw material through photosynthesis by utilizing solar energy. A part of food synthesized by the producers is used in their body building, while the rest is utilized in providing energy for various life activities.

- **Some common predator food chains are given below :**
- Vegetation → Grasshopper → Shrew → Hawk
- Vegetation → Rabbit → Wolf → Tiger

- Vegetation → Frog → Snake → Peacock
  - Plant → Rat → Snake → Hawk.
  - **Aquatic food chains :**
  - Phytoplanktons → Zooplanktons → Small crustacians → Predator insect → Small fish → Large fish → Crocodile
  - Phytoplanktons → Zooplanktons → Small fish → Large fish → Shark
  - Phytoplanktons → Zooplanktons → Fish → Crane → Hawk.

15.3 FOOD WEB :

In nature, the food chins are not isolated sequences but are rather interconnected with one another. "A network of food chains which are interconnected at various trophic levels, so as to form a number o feeding connection amongst different organisms of a biotic community is called as food web. The food web opens several alternate pathways fro the flow of energy. Generally, food web operates according to test and food performances of the organisms at each trophic level, yet availability of food source and other compulsions are equally important. The concept of food web appears to be more real than that of simple food chain. The food web increases the stability of an ecosystem by providing alternate source of the food and allowing endangered population to grow in size. Many food chains are interlinked together to form food web in a big ecosystem in which flow of food takes place through many directions such as forest. A food web which is present in forest ecosystem is a highly complex and permanent (stable) type of food web.



- As much as food web complexes are there as much ecosystem is permanent or stable, such type of ecosystem does not degenerate naturally and continues for longer time period.
- The ecosystems which have simple food webs are not more stable. It means that this type of food web can be finished at nay time. Any attack or cutting of plants can causes the destruction of while ecosystem e.g. Gondwana forest is converted into the desert by the activity of men. this is the example of desertification by men.

DIFFERENCE BETWEEN FOOD CHAIN AND FOOD WEB

Food chain	Food web
1. Food chain is the straight single path of transfer of food energy in the ecosystem.	1. t consists of a number of inter – connected food chains through which food energy is passed in the ecosystem.
2. Members of higher trophic level feed upon a single type of organisms of lower trophic level.	2. Members of higher trophic level can feed as a number of alternative organisms of the lower trophic level.
	3. Presence of food web increases the stability of the ecosystem.

15.4 ECOLOGICAL PYRAMIDS :

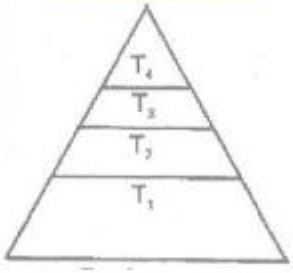
An ecological pyramid is a graphical representation of an ecological parameter like number of individuals or amount of biomass or amount of energy present in various trophic levels of a food chain with producers forming the base and top carnivores from the tip. Ecological pyramids could be upright, inverted or spindle shaped. There are three important parameters of each trophic level in a food chain i.e. number of individual, amount of biomass and amount of energy.

15.4 (a) Pyramid of Number :

In this type of pyramid the number of individual organisms in various trophic levels is shown. These pyramids may be upright or inverted. The number of organisms of any trophic level depends upon the availability of organisms which are used as food on lower level so that availability of food is the main factor. These producers are of two types :

(i) Phytoplanktons : They are the inactive floating plant, because hey do not have locomotors organs **e.g.** Diatoms.

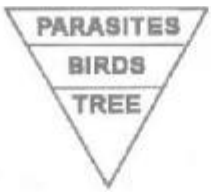
(ii) Phytonektons : These plants swim actively in water, because in them locomotary organs are present. Usually flagella are preset in these plants. **e.g.** Chamydomonas and dinoflagellates. The number of phytoplanktons and phytonketons are higher per unit area of water because they are unicellular.



Producers

Pyramid of Number in Aquatic Ecosystem

• In a tree ecosystem the pyramid of number is inverted. This is called as **parasitic ecosystem** because bird depend upon tree and parasites depend upon birds. Therefore with the increase in the number of trophic levels, the number of the organisms increases sequentially.



Pyramid of number in tee ecosystem

- Pyramid of number shows biotic potential of an ecosystem.

- The number of members of any particular species in a favorable condition is called as their **biotic potential.**
- When the number of the members of any species increases then it is called as **population explosion.**

15.4 (d) Pyramid of Biomass :

The biomass of each trophic level is shown by this pyramid. Mostly these pyramids are also upright (erect). e.g. Tree ecosystem.

- Pyramid of biomass in **aquatic ecosystem** is **inverted,** because in this producers are micro organisms and their biomass is lesser than other trophic levels.
- Pyramids of biomass show the standing crop of ecosystem. It means total amount of living matter at a particular time in an ecosystem is called as **standing crop.**
- Total amount of nonliving matter in an ecosystem is called as **standing state.**

15.4 (c) Pyramid of Energy :

It always remains erect, because flow of energy is not cyclic. i.e. during the flow of energy at each trophic level goes on decreasing.

- According to the **10% law of Linderman** the 90% part of obtained energy of each organism is utilized in their various metabolic activities and only 10% energy transferred to the next trophic level. So that 90% energy is lost at each trophic level therefore, top consumers like lion etc., are weakest ecologically.
- Pyramids of energy show the productivity of any ecosystem.
- **Plant community :** All types of plants present at a particular place to form a community, is called as plant community. The distribution of any species at a place depends upon social nature of the species which indicates cooperation between them.
- **Synecology :** The ecological study of any plant community is called as **"gynecology".**
- **Phytosociology :** The study of structure of plant community is known as **"phytosociology"**
- **Phytogeography :** The study of distribution of the plants on the earth is called as **"phytogeography".** Some characteristics of plant community are as follows :

(i) Species diversity : There are many verities of organisms found in a community. The total number of species of plants called as **population.** The ecological study of population is called as **Autecology's.** The maximum species diversity is found in **tropical forest.** The plants are called as **flora** and animals are termed as **fauna.** The lowest species diversity is found in **Tundra biome or Arctic desert.**

(ii) Dominant species : The highest number of plants of a species present in a community is called as dominant species and whole plant community is knows as the name of the species. Such as **Prosop is community on Aravali hills** and **Aravali hills** and **Pinus community on Himalaya.**

- **B.O.D.** It shows the deficiency of oxygen in the water. Daphnia is the indicator of B.O.D.

15.5 OZONE LAYER DEPLETION :

Between 20 and 26 km above the sea level ozone layer is present and the part of atmosphere containing it is called ozonosphere (Stratosphere). This layer is established due to an equilibrium between photo dissociation of ozone by UV - radiations and regeneration of ozone. The thickness of this ozonosphere averages 5 km. The ozone layer acts as an ozone shield and absorbs the harmful UV - radiations of the sunlight so protect the earth's biota form the harmful effects of strong UV - radiations. So this layer is very important for the survival and existence of life on earth.

15.5 (a) Causes of Thinning of Ozone Layer :

The decline in spring - layer thickness is called ozone hole. Ozone hole is largest over Antarctica and was just short of 27 million sq. km. during September 2003. Main chemicals to be responsible for destruction of ozone - layer are : chlorofluorocarbons (CFCs), halogens (used in fire extinguishers), methane and nitrous oxide. Out of these, most damaging is the effect of CFCs which are a group of synthetic chemicals and are used as collants in refrigenratorsare a group of synthetic chemicals and are used as collants in refrigerators and air conditioners; as cleaning solvents, propellants and sterilant etc. These CFCs produce "active chlorine" in the presence of UV - radiations. These active chlorine radicals catalytically destroy ozone and convert it into oxygen. Ozone at the higher levels of the atmosphere is a product of UV radiation acting on oxygen (O_2) molecule. The higher energy UV radiations split apart some molecular oxygen (O_2) into free oxygen (O) atoms. These atoms then combine with the molecular oxygen to form ozone as shown -

$$O_2 \xrightarrow{UV} O + O$$

$$O + O_2 \longrightarrow \underset{\text{(Ozone)}}{O_3}$$

In 1987, the United National Environment Programme (UNEP) succeeded in forging an agreement to freeze CFC production at 1986 levels.,

- **Nitrous oxide:** is produced in industrial processes, forest fires, solid waste disposal, spraying of insecticides and pesticides, etc. Methane and nitrous oxide also cause ozone destruction.

15.5 (b) Effects of Ozone Layer Depletion :

The thinning of ozone layer results in increase in the UV radiation (in the rage of 290 - 320 nm) reaching the earth's surface. It is estimated that 5 percent loss of ozone results in 10 per cent increase in UV - radiations. These UV - radiations can :

(i) Increases in incidences of cataract and skin cancer.

(ii) Decrease in the functioning of immune system.

(iii) Inhibit photosynthesis in most of phytoplankton so adversely affecting the food chains of aquatic ecosystems.

(iv) Damage nucleic acids of the living organisms.

15.6 MANAGEMENT OF NATURAL RESOURCES :

15.6 (a) Introduction :

We often hear or read about environmental problems. These are often global-level problems and we feel helpless to make any changes. There are international laws and regulations, and then there are our own national laws and acts for environmental protection. There are national and international organisations also working towards protecting our environment. The multi crore project of **Ganga Action Plan** came about in 1985 because the quality of water in the ganga was so poor.

15.6 (b)Pollution of the Ganga:

The Ganga runs its course of over 2500 km from Gangotri in the Himalayas to Ganga Sagar in the Bay of Bengal. It is being turned into a drain by more than a hundred towns and cities in Utter Pradesh, Bihar and West Bengal that pour their garbage and excreta into it. Largely untreated sewage is dumped into the Ganga every day. In addition pollution is caused by other human activities like bathing, washing of clothes and immersion of ashes or unburnt matter also. And then, industries contribute chemical effluents to the Ganga's pollution load and the toxicity kills fishes in large section of the river.

- **Three R's to save the environment :**

(i) Reduce : This means 'to use less'. We van save electricity by switching off unnecessary lights and fans. We can save water by repairing leaky taps.

(ii) Recycle : This means that we can collect plastic, paper, glass and metal items and recycle these materials to make required things instead of synthesizing or extracting fresh plastic, paper, glass or metal. In order to recycle, we first need to segregate our waste so that the material that can be recycled is not dumped along with other waste.

(iii) Reuse : This is actually even better than recycling because the process of recycling uses some energy. In the 'reuse' strategy, we can simply use things again and again.

15.6 (c) need of Manage Our Resources :

Our natural resources are limited with the rapid increase in human population. Due to improvement in health care, the demand for all resources is also increasing. Management of natural resources requires long term perspective to meet the needs and aspirations of future generations. Natural resources should be managed in such a way that every one of the society is benefited from its development. The waste generated from exploration of natural resources should be disposed off safely. For instance, mining causes pollution due to discard of large amount of slag during metal extraction.

15.7 SUSTAINABLE DEVELOPMENT :

It is the development which can be maintained for a long time without undue damage to the environment. The objective of sustainable development is to provide the economic well being of the present and the future generations and to maintain a healthy environment and life support system. It encourage forms of growth that meet current basic human needs, thus sustainable development implies a change in all aspects of life. It depend upon the willingness of the people to change their perceptions of the socio economic environmental conditions and use of natural resources.

15.8 BIODIVERSITY :

It is the existence of a wide variety of species of plants, animals and microorganism in a natural habitant within a particular environment. Biodiversity of an area is the number of species or range of different life forms found there. Forests are 'biodiversity hotspots'.

15.9 PRACTICES FOR CONSERVATION AND PROTECTION OF ENVIRONMENT :

Conservation means 'to keep safe' whereas preservation means 'to maintain the environment at it is'. Various practices which can help in conserving and protecting our environment are as follows :

- The practice of crop rotation helps in conserving soil.

- Judicious use of fertilizers, intensive cropping, proper irrigating and drainage help in the conservation of soil.
- The treatment of sewage prevents pollution of water bodies and helps in conserving fishes and other aquatic life forms.
- National parks and wildlife sanctuaries should e established throughout the country in order to protect and conserve will animals, birds and plant species.
- New trees should be planted in place of those cut for various purposes, which will protect the earth from excessive heating.
- Harvesting of rain helps in the conservation of groundwater.
- Composting of solid organic waste for biogas and manure.

15.10 WILDLIFE :

It means all those naturally occurring animals, plants and their species which are not cultivated, domesticated and tamed.

15.10 (a)Conservation :

It is the sensible use of the earth's natural resources in order to avoid excessive degradation and betterment of the environment. It includes - the search for alternative food and fuel supplies when these are endangered, an awareness of the dangers of pollution and the maintenance and preservation of habitats and its biodiversity.

(i) Steps for conservation of wildlife :

(A) Laws should be imposed to ban poaching or capturing of any animal or bird belonging to an endangered species.

(B) The natural habitats of wild animals and birds should be preserved by establishing National Parks, Sanctuaries and Biosphere reserves throughout the country.

(C) The Government Department should conduct periodic surveys of National Parks, Sanctuaries and Biosphere Reserves to have a knowledge of all the species of wild animals and birds.

(D) More attention should be given to conserve the endangered species of wild animals and birds to prevent their extinction.

(E) Unauthorized cutting of forest trees should be stopped.

15.11 STAKEHOLDERS OF FORESTS :

The conservation of forests depend on its forest resources or its various stakeholder, who are as follows :

15.11 (a) People Who Live in or Around Forests :

(i) They depend on forest produce, for various aspects of their life.

(ii) The local people need large quantities of firewood, small timber.

(iii) Bamboo is used to make slats for huts and baskets for collecting and storing food.

(iv) Implements for agriculture, fishing and hunting are largely made of wood.

(v) People collect fruits, nuts and medicines from forests, their cattle also graze in forest.

15.11 (b) Forest Department of the Government :

(i) Which owns the land and controls the forest resources.

(ii) People develop practices to ensure that forest resources are used in a sustainable manner.

(iii) The forest resources were overexploited after the British took control of the forest.

(iv) Forest department of independent India then owned the land and control the resources of the forest but local needs such as herbs, fruits and fodder were ignored.

(v) Monoculture of pine, teak or eucalyptus have been started which can destroy the bio-diversity of the area.

15.11 (c) Industrialist :

(i) Industries consider the forest as a source of raw material for its factories.

(ii) These industries are not interested for the sustainability of the forest in one area as they go to a different area after cutting down all tree in one area.

15.11 (d) Wildlife and Nature Enthusiasts :

(i) They are not dependent of the forest but conserve nature and take part in its management.

(ii) Conservationists started with conserving large animals but are now preserving biodiversity as a whole.

(iii) The local people, for instance the Bishnoi community in Rajasthan worked for conservation of forest and wildlife as a religious act. Thus management of forest resources has to take the interests of various stakeholder into account.

15.12 TRADITIONAL USE OF FOREST :

- Alpine grasslands in Himalayas were grazed by sheep in summer.
- Nomadic shepherd drove their flock every summer in this area.

15.12 (c) Causes of Damages to Forests :

(i) Local people damage forest to fulfill their daily needs.

(ii) Deforestation caused by industrial needs.

(iii) Deforestation caused for development projects like building roads or dams.

(iv) By tourists or in making arrangements for tourists.

15.12 (b) Conservation of Forests :

- **it includes the following methods :**

(i) Afforestation . It is the practice of transforming an area into forest have not grown there, it involves

three types of forestry programmes.

(A) Social and Environmental forestry. It involves raising of trees for firewood, fodder and agricultural implements for the benefit of rural and trial community.

(B) Agro forestry. It is an absolute commercial forestry developed to fulfill the need of various forest based industries. It is done on the fallow land or free-grazing lands.

(C) Urban forestry. In involves growing of ornamental trees along roads, vacant lands and common parts of urban areas.

(ii) People participation in forest management :

(A) The Sal forests in West Bengal got reduced alarmingly in 1972.

(B) Surveillance and policing to protect resulted frequent clash between forest official and the villagers.

(C) The department then changed its strategy and in Asabari forest, villagers were involved in protection of the badly damaged Sal forest.

(D) In return, villagers were given employment and were allowed to collect firewood and fodder at nominal fee.

(E) By 1983, the Asabari forest showed a remarkable recovery.

(iii) Economic growth and Ecological conservation :

(A) Forest resources should be used in an environmentally and developmentally sound manner.

(B) The benefit of controlled exploitation of resources goes to the people and the environment is also preserved.

(C) If the exploitation is too high, economic and social development will be faster but the environment will further deteriorate.

(D) We should use natural resources cautiously so that economic growth and ecological conservation go hand in hand.

(E) Amrtia Devi Bishnoi National Award. In 1731, Amrita Devi Bishnoi sacrificed her life along with 63 persons for the protections of 'Khejri' trees in Khejrali village near Jodhpur in Rajasthan. In the memory Government of India have recently instituted this award for Wildlife Conservation.'

(F) Chipko Movement : During 1970, In Reni village of Garhwal, a contractor was allowed to cut trees in a forest near the village. When the contractor's workers went to the forest to cut trees the woman of the village hug the tree trunks to prevent the workers from cutting trees, Chipko means 'hug' and the movement started by the villagers by hugging tees is called **Chipko Andolan'.**

15.13 WATER AS A BASIC NATURAL RESOURCE :

- It is a valuable national asset.
- It is the main requirement of human being.
- Water is of two types - salt water and fresh water.
- Fresh water is an unlimited natural resource, it can be obtained from three natural resources - rain water, surface water and ground water.
- Human intervention pollutes water and also changes the availability of water in various regions.

15.13 (a) Water Sources :

(i) Rain in India re due to monsoon.

(ii) Failure to sustain underground water due to loss of vegetative cover, development of water demanding crop and pollution from industrial effluents.

(iii) Small dams, canals and tank were used for irrigation purpose and to fulfill the basic minimum needs.

(iv) Large dams and canals were made by British as well as our own government.

(v) Due to the mega project, local irrigation methods got neglected and the local people lost control over management of local water sources.

(vi) Large dams and canals were made by British as well as our own government.

13.13 (b) Management of Water Resources :

It includes :

(i) Interacted water-shed plan for drinking, irrigation and industrial uses.

(ii) Flood control

(iii) Transfer of surplus water to water deficit basins by inter-linking of rivers.

(iv) Hydro geological survey to identify over-exploited areas.

(v) Artificial recharging of the ground water.

(vi) Mass awareness programmes through public or private agencies.

(vii) **Dams :** They are massive barriers built across rivers and streams to confine and utilize the flow of water for human purposes such as irrigation and generation of electricity.

- Large dams can also ensure the storage of adequate water.

• Canal system leading from dams transfer large quantity of water upto great distances, e.g. Indira Gandhi Canal or Rajasthan brought greenery to considerable areas.

- **Purposes for building a dam :**
- Generation of electricity
- Irrigation
- Control of flood which either stops or slows the amount of water in the river.
- **Criticism about large dams :**
- **Social problems :** They displace large number of farmers and tribals.
- **Economic problems :** They consume huge amount of public money without proportionate benefit.

- **Environmental problems.** As they cause deforestation and loss of biological diversity.

15.13 (c) Mismanagement of Water Distribution :

Due to mismanagement in distribution of water, the benefit of contracting a dam goes to few people only. **For example,** people close to the water source grow water intensive crop like sugarcane and rice while people farther downstream do not get any water. This resulted in discontentment among the people who has been displaced by building of dam.

(i) Watershed management : It means scientific conservation of soil and water to increase the biomass production.

• Watershed management not only increases the production and income of the watershed community but also overcomes drought and flood.

• It increases the life of downstream dam and reservoirs.

(ii) Water harvesting : It means capturing rainwater where it falls or capturing the runoff water in a local area and talking measures to keep the water clean by not allowing polluting activities to take place.

(A) Techniques of water harvesting : Water harvesting techniques are mainly location specific. It is an age - old concept in India.

• Khadins, tanks and nadis in Rajasthan.
• Bandharas and tals in Maharashtra
• Ahars and Pynes in Bihar
• Kulhs in Himanchal Pradesh
• Ponds in kandi belt of Jammu.
• Eris (tanks) in Tamilnadu.
• Suragams in kerala.
• Kattas in Karnataka.
• Due to own control of the local population over exploitation of the local water

resources in reduced.

(B) Some of the water harvesting techniques are :

• Capturing of runoff water roof tops.
• Capturing of runoff water from local catchments.
• Capturing seasonal flood water from local streams.

(C) Benefits of water harvesting :

• Provide drinking water.
• Provide irrigation water.
• Increase in ground water resources.
• Reduces storm water discharge, urban flood and overloading of sewage treatment plants.

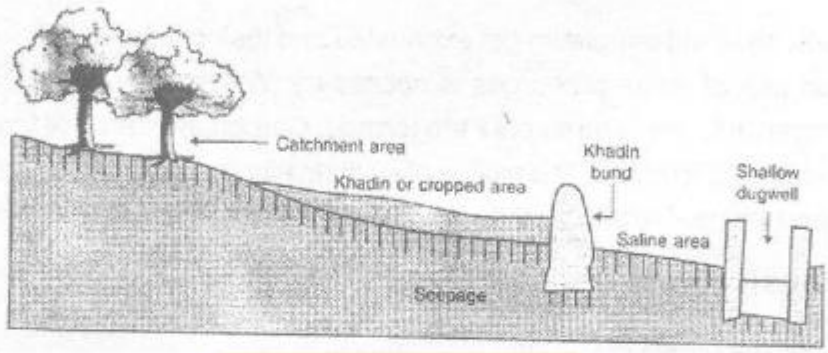
(D) Advantages of ground water :

• It does not evaporate.

- It spreads out to recharge wells.
- It provides moisture for vegetation.
- It does not provide breeding grounds for mosquitoes.
- It is relatively protected from contamination by human and animal waste.

(E) Traditional water harvesting system :

- The water harvesting structures are mainly crescent shaped.
- Monsoon rains fill ponds behind the structures.
- The large structure hold water throughout the year while most dry up after monsoon.
- The main purpose of this system is to recharge the ground water and not to hold surface water.



Traditional water harvesting system

15.14 FOSSIL FUELS :

These fuels are obtained from the remain of plants and animals, which got buried beneath the earth millions of years ago, changed into coal, petroleum and natural gas due to excessive heat and high pressure inside the earth.

15.14 (a) Non-Renewable Energy Sources :

These are energy sources which cannot be replaced easily when the get exhausted and are also called conventional sources of energy. They are used traditionally for many years and take millions of years to form **e.g. Fossil fuels.**

(i) Coal : It contains carbon and its compound mainly with nitrogen, oxygen, sulphur and hydrogen. It also consists of inorganic matter.

(ii) Petroleum : 'Petro' means rocks and 'oleum' means oil, petroleum is therefore the oil found in rocks. It is a complex mixture of solid, liquid and gaseous hydrocarbons. It also contains small amounts of other compounds of carbon, hydrogen, oxygen, nitrogen and sulphur. Large reservoirs of petroleum have been preserved by nature for millions of years between porous rocks beneath the earth.

15.14 (b) Formation of Non-Renewable Energy Sources :

(i) Formation of coal. Coal is formed organic matter which got buried under the earth 300 million years ago. Due to high pressure and temperature inside the earth, this organic matter changed into coal, that is why, coal is called fossil fuel.

(ii) Formation of petroleum. It is formed by the decay of very small (tiny) marine animals and plant buried under the earth about 400 million years ago. Due to excess of heat and pressure it changed into oil called petroleum. It is a fossil fuel.

15.14 (c) Conservation of Coal and Petroleum :

It means more efficient use with regard to economic, social and environmental cost and benefits which result in attainment of higher efficiency, minimisation of wastage and protection of the environment.

• We can conserve coal and petroleum by their judicious use and substituting them by other resources wherever feasible. Conservation of coal and petroleum is a joint responsibility of the industries, citizens and government where each one has significant role in Management of Natural Resources.

15.14 (d) Necessity of Judicious Use of Coal and Petroleum :

The fossil fuels, coal and petroleum get exhausted and their combustion pollutes our environment, so a judicious use of these resources is necessary. When combustion take place, oxides of carbon, hydrogen, nitrogen and sulphur are formed. Carbon monoxide is formed instead of carbon dioxide if there is insufficient are. The oxides of sulphur, nitrogen and carbon monoxide are poisonous at high concentrations. Carbon dioxide is a green-house gas which leads to global warming.

15.14 (e) Uses of Fossil Fuels :

(i) In thermal power plants and steam engines.

(ii) Petroleum products like petrol and diesel are used as fuel in motor vehicles and ships. Other products like kerosene and LPG are used for cooking purpose.

15.14 (f) Management of Fossil Fuels :

The natural gas is a good alternative to fossil fuels like coal and petroleum. The use of alternative source of non-conventional energy such as solar energy, which energy, biomass energy, etc., should be promoted to save the reserves of fossil fuels. Biogas can also be used for various purposes.

DAILY PRACTIVE PROBLEMS # 15

OBJECTIVE QUESTIONS

1. Ecosystem term was coined by

(A) Odum (B) Mishra (C) Reiter (D) Tansley

2. Pyramids of biomass are

(A) upright or inverted (B) always inverted (C) mostly upright (D) mostly inverted

3. Vultures in an ecosystem are

(A) predators (B) scavengers (C) consumers (D) top carnivores

4. In which of the following trophic levels in any ecosystem the maximum energy is stored ?

(A) Producers (B) Herbivores (C) Carnivores (D) Top carnivores

5. In an ecosystem the

(A) primary producers are more than that of primary consumers

(B) secondary consumers are largest, because they are powerful

(C) primary consumers are out of number

(D) primary consumers are least dependent upon primary producers

6. In an ecosystem the function of the produces is to

(A) convert organic compounds into inorganic compounds

(B) trap solar energy and convert in into chemical energy

(C) utilize chemical energy

(D) release energy

7. The importance of ecosystem lies in

(A) flow of energy (B) cycling of materials (C) both of the above (D) none of the above

8. In other to maintain proper ecological balance

(A) the existing forests should be cleared and new ones should be planted

(B) some quick growing annuals should be planted if a tree must be cut for other uses

(C) tree must be curt whenever necessary because the underground part performs the useful purpose

(D) a tree should be planted in place of one to be cut

9. A biosphere is composed of

(A) living organisms

(B) living organisms and lithosphere

(C) living organisms, lithosphere and atmosphere

(D) living organisms, lithosphere, atmosphere and hydrosphere

10. Pyramid of energy in a forest ecosystem is

(A) always inverted

(B) always upright

(C) both upright and inverted

(D) first upright then inverted

SUBJECTIVE QUESTIONS

SHORT ANSWER TYPE QUESTIONS

1. How is ozone formed in the stratosphere ?
2. What is the function of ozone layer ?
3. Write a note on ozone depletion.
4. What is the significance of wildlife ?
5. What are fossil fuels ?

LONG ANSWER TYPE QUESTONS

6. What is ecosystem ? Explain the food chain and food web.
7. Explain the different components of ecosystem.
8. What is meant by management and conservation of natural resources ?
9. What is significance of biodiversity ?
10. What is the name of the award given in honour of the movement started for protection of 'Khejri' trees ?
11. Why is the management of forest and wildlife resource considered as a challenging task ?

ANSWERS

DAILY PRACTIVE PROBLEMS # 15

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

ORIGIN AND ECOLUTION OF LIFE

BL - 16

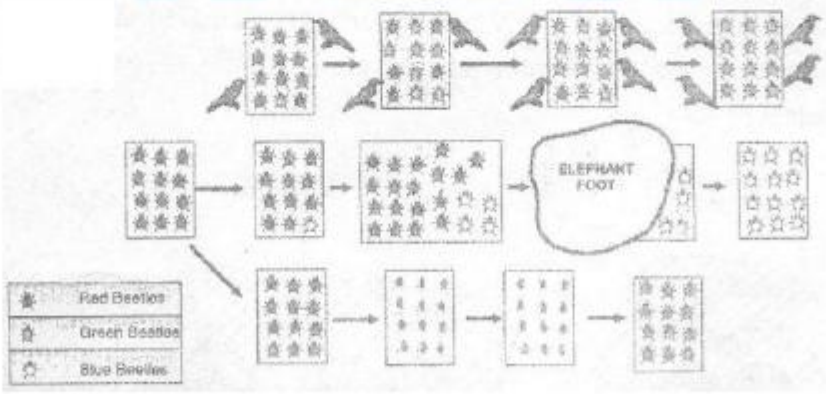
16.1 INTRODUCTION :

All living organisms have arisen through the evolutionary process and show diversity, yet some similarities exist among them. e.g. Amphibians, reptiles and mammals have limbs for locomotion in water, fishes have fins for swimming in water and birds have wings for flying.

- A close examination reveals that the limb, fins and wings are formed on the same basic structural plan.
- All such examples can be explained if we consider that the diverse groups of organisms share a common ancestor from who they have diverged and formed two different species. Such process of change in biological system is called as **evolution.**
- The Doctrine of the **Organic Evolution** state that the organisms existing at present are the descendants of much simpler ancestors.

16.2 EVOLUTION :

The term **'Evolution'** means **"unrolling or unfolding"** change from one condition to another. It means members of a species change generation after generation with environmental requirements to turn into better organized and more complex new species. The changes in the properties of population of organisms or groups of such populations over the course of generations are considered as organic evolution. It is a process of cumulative change of living populations and in the descendant populations of organisms. In other words, it is **"descent with modifications."** Evolution is a change in the genetic composition of a population. There is an inbuilt tendency of variation during reproduction, both because of errors in DNA copying and as a result of sexual reproduction.



Variations in a population –inherited and otherwise

- **Illustration.** Let us consider a group of twelve red beetles, which reproduce by sexual reproduction and lives in the bushes with green leaves. They are preyed upon by crows. As we know that more the crows eat, the fewer beetles are available to reproduce. Now let us consider various causes of variation in the population of red beetles.

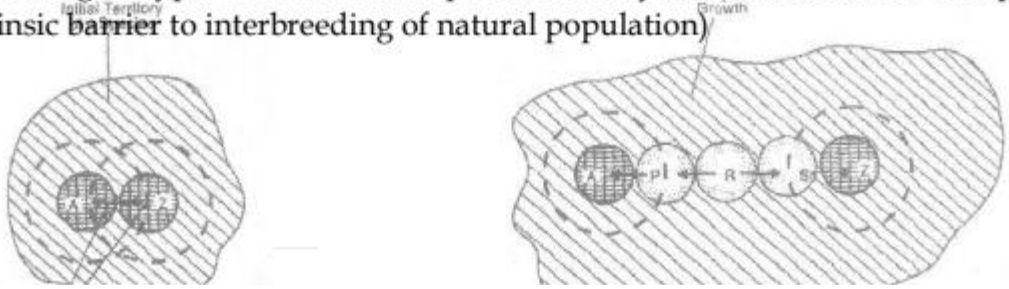
- **Case I.** The process of sexual reproduction results in the formation of few green beetles instead of red beetles. These green beetles were able to pass the colour on to its progeny, so that all it progeny beetles are green. These green beetles cannot be seen by crows so, they are not eaten. As a result, with passage of time there will be more number of green beetles than red beetles. In this case, natural selection is directing evolution in the beetle population. The natural section is exerted by the crows. The more crows there are, the more red beetles would be eaten and more the proportion of green beetles in the population would be. So, natural selection brings about improved adaptive relative between organisms and environment by favouring the reproduction and survival of those individuals which are found more suited to the given environment.

- **Case II** The process of reproduction again results in the formation of another colour variant i.e., blue colour beetles. These beetles were also able to pass the colour on to its progeny, so that all its progeny beetles are blue. These beetles can be seen by crows, so they are eaten. in initial stages there are more number of red beetles in comparison to blue beetles in a population. But at this point, an elephant comes by and stamps on the bushes where the beetles live This kills most of the beetles. But by change free beetles that have survived are mostly blue. These beetles (blue) will now slowly increase their number. In this case, the colour change gave no survival advantage. It is simply a matter of accident survival of beetles of one colour that changed the common characteristics of the resultant population. The elephant would not have caused such major havoc in the beetle population if the beetle population had been very large. This random change in the gene frequency occurring by change irrespective of its being beneficial or harmful is called genetic drift. For this reason, is small population, some unfavourable characters may also be fixed or beneficial characters may be lost.

- **Case III.** In this case, beetle population goes on increasing but, the bushes stat suffering from a plant disease. The amount of leaf material for the beetles is reduces so that average weight of adult beetles is reduced. The average weight of adult beetles decreases because of scarcity of food. After a few years, when bushes once again become healthy due to the absence of disease, then the average weight of beetles should once again increase, due to adequate availability of food.

16.3 SPECIATION :

- **Speciation is Origin of New Species :** A species comprises of several populations. Interbreeding is very frequent among the individuals of a population and is occasional among the populations of a species whereas inter breeding is absent among the individuals of different species. There is a free gene flow within the members of a population and a free gene flow could be maintained among the members of different population of a species, provide an opportunity to interbreed. But free gene flow between two species does not occur on account of marked difference in their genotype, it means new species arise by the establishment of reproductive isolation (intrinsic barrier to interbreeding of natural population)



The separation of species populations in due course of time

Consider that beetle population has become very large and has spread over a mountain range. The individual beetles feed mostly on a few nearby bushes throughout their life time. So, in this huge population of beetles, there will be sub-populations in neighborhood. The process of reproduction will occur mostly within these sub populations or rarely between two different sub-populations. So, gene flow will take place between two different sub populations. If, however between two such sub-populations a large river or a creeping glacier or a mountain cut develops then the two populations will be further isolated. The levels of gene flow will further decrease between two populations. Over generations the process of natural selection and genetic drift will further isolate two sub-populations of beetles. Now, members of these two sub-groups will be incapable of reproducing even after they meet each other.

There can be a number of ways by which interbreeding between two beetles of two subgroups stop. The changes in DNA structure or number of chromosomes will make the gametes incompatible and prevent fertilization. The morphology of reproductive organs may change, which prevents compatibility and fertilization. The difference in the Behaviour of male and female will also prevent mating. The organisms may have developed different breeding periods.

16.3 (d) Evolution by Stage:

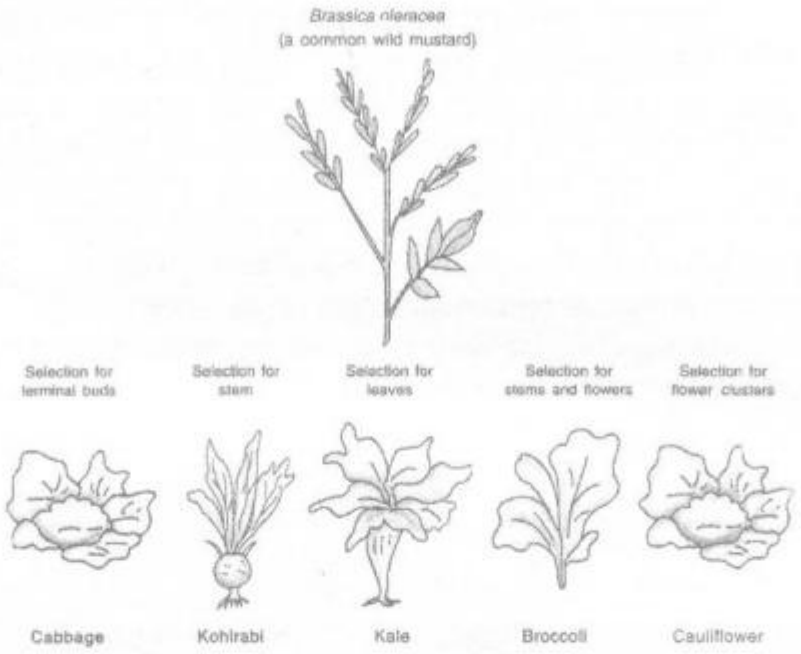
The evolution in an organism or its organs from simple to complex forms has taken place in stages. It is has taken bit by bit over generation. The evolution cannot takes place by a single DNA change. Let us take few examples.

(i) Feathers were firstly developed dinosaurs, but they could not fly. Probably, it was developed to provide insulating in cold weather. Later on feathers developed in birds, where they were used for flight. This indicates that birds are closely related to reptiles (dinosaurs were reptiles). Also indicates that the character which developed for one function is late on used for different function.

(ii) Eyes for the first time developed in Planaria. Rudimentary eyes present in Planaria and just photosensitive eyespots. Simple as well as compound eyes have developed in insects and crustaceans. Eyes have also developed in Octopus and vertebrates. The structure of the eye in each of these organisms is different enough for them to have separate evolutionary origins.

Planarian has very simple eyes

(iii) Man has been taking the advantage of genetic variations for improving the qualities of domesticated plants and animals. He selected the individuals with desired characters and separates them from those which do not have such characters. The selected individual are interbred. This process is termed as artificial selection. If it is repeated for many generations it produces a new breed with desired characters.



Some crop plants produced by selective breeding

(iv) By this selections process, very dissimilar looking structures may evolve from a common ancestral design. One of the classical examples is wild cabbage plant. Humans have cultivated wild cabbage as a food plant, and generated different vegetables from it by selection even more than two thousand years ago. The various crop plants developed from wild cabbage plants are :

- **Cabbage :** it is selected for its terminal buds, where there is a very short distance between leaves.
- **Kohlrabi :** It is selected for its swollen stem position.
- **Broccoli :** It is selected for its flowers (arrested flower development) and stem.
- **Cauliflower:** it is selected for its flower cluster (sterile flowers). The other way of tracing evolutionary relationship depend on the changes in DNA during reproduction. If we compare the DNA of different species then we can directly estimate how much DNA has changed during the formation of these species.

16.4 ORIGIN OF LIFE :

Several theories have been put forward to explain the origin of life.

16.4 (a) Theory of Special Creation :

According to this theory life was created by some **Super Natural Power (God).** This theory has not evidence, hence it is a rejected theory.

16.4 (b) Theory of Spontaneous Generation :

According to this theory life is originated repeatedly from nonliving materials, automatically from time to time. This theory was supported by **Thales** and **Aristotle.**

16.4 (c) Theory of Biogenesis :

Scientist like **Redi, Lazzaro Spllanazani, Louis Pasteur** proposed and proved the biogenesis concept of **Huxley** and **Harvey** that new organism arises from pre-existing ones.

16.4 (d) Cosmozoic Theory :

It states that, life came to earth from some heavenly bodies in the form of spores and seeds.

16.4 (e) Modern Theory (Naturalistic Theory) :

Life originated upon earth by a long series of physiochemical changes which brought about a gradual evolution of first inorganic and then organic compounds (chemical evolution). It results in the formation of protoplasm. This includes -

(i) Oparin - Haldane Theory.

- It independently proposed the origin of life by chemical evolution.
- Oparin's views were later on published in his book **"The origin of life".**
- According to this theory earth was formed about 4600 million years ago. The atoms of nitrogen, hydrogen, oxygen, argon, carbon etc. formed the primitive atmosphere.
- The atmosphere was reducing because hydrogen atoms were most numerous and most reactive in the primitive atmosphere.
- As, the earth began to cool, it's matter began to condense. But still it was so hot that water could exist only in vapour form.
- Large quantities of H_2, N_2, water vapours, CH_4 and NH_3 were present, but free oxygen was not present in significant amount.
- Further fall in temperature allowed H_2O to remain in liquid form so that oceans and water bodies were formed containing large amounts of dissolved NH_3, CH_4, HCN, nitrides, carbides and various gases.
- Reacting with water and it's oxygen, simple saturated hydrocarbons such as CH_4 formed unsaturated hydrocarbons like ethylene, acetylene. Later aldehydes, ketones, alcohols and organic acids were formed.
- Abundant energy was available in the form of heat, cosmic rays and lightening. Using this energy, the organic molecules of ocean water formed complex compounds like amino acids, sugar, glycerol, fatty acids, nitrogenous organic bases etc.
- These molecules further formed large linear polymers, or macromolecules like protein, carbohydrates, and fats, the oceanic water became a rich mixture of organic compound called **"Prebiotic soup".**

(ii) Stanley Miller and H.C. Urey Experiment [Experiment for verification of prebiotic soup] :

- This experiment verified the **Oparin Haldane theory** by creating [stimulating] in their laboratory the probable conditions on the primitive earth.

- They built an apparatus of glass tubes and flasks and created as atmosphere containing H_2, CH_4, NH_3, H_2O in one chamber - energy was also supplied by electric sparks.
- The resultant mixtures were allowed to condense. Experiment was run for one week. Chemical composition of the liquid revealed **glycine, alanine** and **aspartic acid.**

- Thus biotic synthesis of organic molecules was confirmed

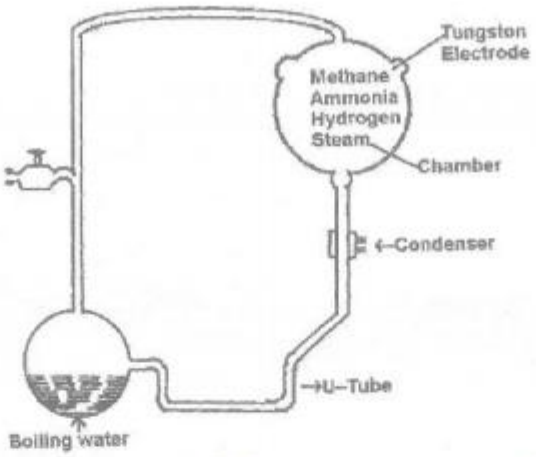


Fig : Miller's Experiment

16.5 ORGANIC EVOLUTION :

(i) Though life originated by chemical evolution on the primitive earth. It was later replaced by organic evolution.

(ii) Organic evaluation states **"Descent with modification"** i.e. present day complex living organism have evolved from earlier simpler organisms by small but gradual changes which have occurred over million of years.

(iii) Though living organisms show great diversity in size, structure, function, Behaviour etc. They also show basically similar metabolic process indicating some common ancestors.

16.6 FOSSILS :

- The plants and animals that lives in remote past have in many cases left proofs of their existence in the form of remains in the rocks. These are called as **fossible.**
- Paleontology **is the study of fossils.**
- **Leonardo-a-vinci** is called as the father of Paleontology.
- Founder of modern paleontology is **George Cuvier.**

16.6 (a) Fossils Can be of Three Different Types :

(i) **Petrified :** Replacement of some of the organic parts by mineral deposits is called as **petrification.**

(ii) **Moulds and casts :** Moulds are hardened and fossilized mud that surrounds a dead organism. Sometimes the moulds are found with petrified fossils of the organisms and then they are called as **casts.**

(iii) Prints : Foot prints or prints of wings, skin, leaves, stem etc. made in soft mud which subsequently became fossilized.

16.6 (b) Dating of Fossils :

It is also called as the **"clock of fossils".** It is the process of determining the age of fossils. This include the following 3 methods.

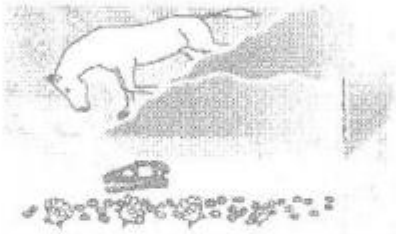
(i) Lead method (ii) Radio Carbon method (iii) Potassium-Argon method

How do fossils form layer by layer ?

Let us start 100 million years ago. Some invertebrates on the sea bed die, and are burred in the sand. More sand accumulates, and sandstone forms under pressure.

Millions of years later, dinosaurs living in the are die, and their bodies, too, are buried in mud. This mud is also compressed into rock, above the rock containing the earlier invertebrate fossils.

Again millions of years later, the bodies of horse-like creatures dying in the area are fossilized in rock above these earlier rocks.



Much later, erosion by, say, water flow ears away some of the rock and exposes the horse-like fossils. As we big deeper, we will find older and older fossils.

16.7 MORPHOLOGICAL EVIDENCES :

16.7 (a) Homologous Organs or Homology :

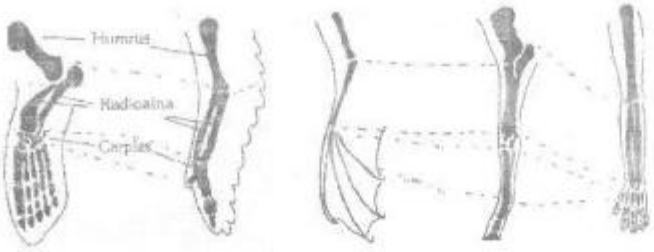
[Same structure but different function] Homology can be defined at the relationship between the structures which have similarity due to common ancestors, although these structures may show difference in their function. **.e.**

(i) fore limbs of vertebrates having pentdactyl limbs of similar origin and similar arrangement of bones,

muscles etc.

(ii) Legs of different insects.

(iii) Teeth of man.



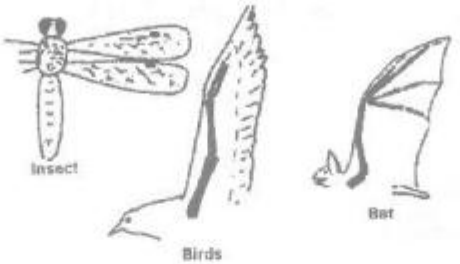
Whale **birds** **Bat** **Horse** **Man**

16.7 (b) Analogous Organs or Analogy :

[Different structure but similar function] Analogy can be defined as a relationship between structures, which though differ anatomically but would have superficial similarity due to similar function.

e.g. **(i)** Wings of insects and wings of birds (ii) Sting of bee and scorpion.

(iii) Find of fishes and flipper of whales.

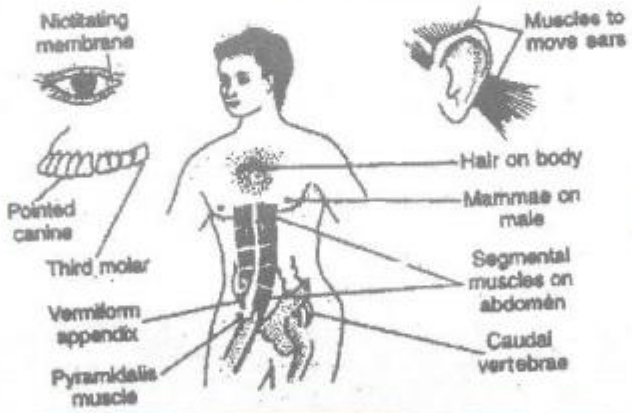


Analogous Organs

16.7 (c) Vestigial organs :

Those organs which have no longer function are known as **vestigial organs. These** organs have reduced structurally as well as functionally.

- It appears that these organs were well developed in ancestors but due to their reduced or less use they became functionless.



Vestigial organs of man

- There are many vestigial organs in human body e.g.

(i) Vermiform appendix in man (ii) External ear in man

(iii) Nictitating membrane (iv) Wisdom teeth

16.8 Common Ancestry and Inter-relationship :

- Various organisms are interconnected.
- Their resemblance suggest a common ancestry **e.g.**
- (i) Heart of fish is two chambered

(ii) Heart of amphibian is three chambered
(iii) Hearts of birds and mammals are four chambered

16.9 CONNECTING LINKS:

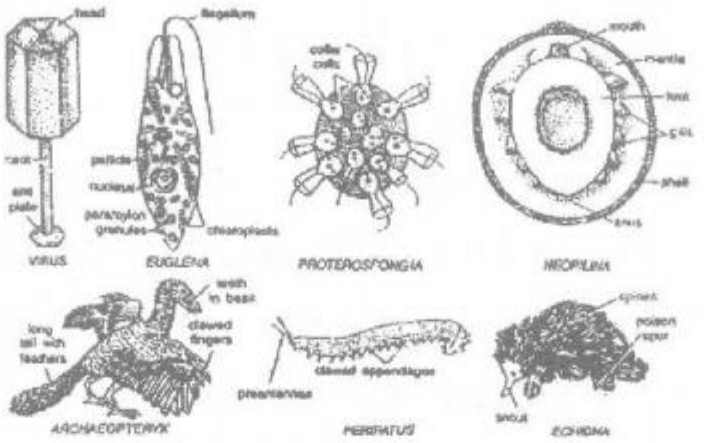
Animals are sharply differentiated and classified into phyla and classes but there are some existing animals which represent an intermediate position between the two groups. Such organisms are called as connecting links e.g.

(i) Lung fish shows connection between fishes and amphibians.
(ii) Amphibian show connecting links between fishes and reptiles.

(iii) Virus shows connecting links between living and non-living.

(iv) Euglena shows connecting link between and animals.

(v) Protopongia between protozoa and porifera.



16.10 Embryological Evidences :

- Embryology can be defined as a branch of science that deals with study of development of an organisms from zygote to an adult form inside the egg or mother's womb.
- The study of embryo's form various organisms reveals similarity in the early stages of embryo development and this theory suggests that these organisms have evolved from common ancestors.

e.g. Embryos of fish, tortoise, child, rabbits and m an show the similarity during embryo development.

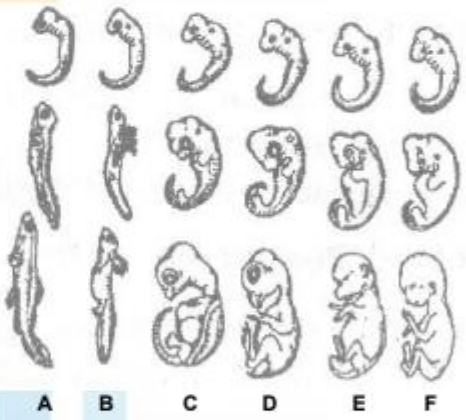


Fig : comparison of stages in the development of vertebrate embryos A. Fish, B, Salamander C. Tortoise, D. Chick, E. Calf, F. Human

16.11 PALENTOLOGICAL EVIDENCES :

- Palaentology is a branch of science that deals with the study of fossils.
- The study of fossils of some of the organisms show similarity between the two groups, e.g. Fossils of **Archaeopteryx** shows characteristics of both reptiles and birds.

16.12 EVIDENCES FROM ATAVISM (REVERSION) :

Sometimes in some individuals such characters appear which were supposed to be present in their ancestors but were lost during the course of development. This phenomenon is known as

atavism or reversion. Atavism proves that animals developing atavistic structures have evolved from such ancestors in which these structures were fully developed **e.g.**

(i) Human baby with tail

(ii) Cervical fistula

(iii) Long and pointed canine teeth represent carnivorous accentors.

(iv) Large and thick body hair reflect our relationship with apes.

(v) Presence of extra nipples (more then two)

16.13 EVIDENCES FROM PHYSIOLOGY AND BIOCHEMISTRY :

Different organisms show similarities in physiology and biochemistry. Some clear examples are-

(i) Protoplasm : Structural and chemical composition of protoplasm is same from protozoa o mammalia.

(ii) Enzymes : Enzymes perform same functions in all animals like trypsin digests protein from Amoeba to

man, amylase digests starch from porifera to mammalia.

(iii) Blood : Chordates show almost same composition of blood.

(iv) ATP: This energy rich molecule is formed for biological oxidation in all animals.

(v) Hormones : Secreted in different vertebrates perform same functions.

(vi) Hereditary material : Hereditary material is DNA in all organisms and is basic structure is same in all animals.

(vii) Cytochrome C: It is a respiratory protein situated in the mitochondria of all organisms. Physiology

and biochemistry thus prove that all animals have evolved from some common ancestor.

16.14 DARWINISM OR THEORY OF NATURAL SELECTION :

"Darwinism" or Theory of natural selection was proposed jointly by **Charles Darwin** and **Alffred Wallace** in 1859. This theory was later on explained by **Charles Darwin** in his Book "**The origin of species"** by means of **"Natural Selection"** (1859)

16.14 (a) Postulates of Darwinism :

He had proposed six important postulates namely

(i) Multiplication of individual of species in a geometric proportion.

(ii) Existence of variation.

(iii) The operation of natural selection on the existing variability in order to select the best fitted variations.

(iv) Due to geometric multiplication and due to the availability of limited food and space for these

individuals the struggle for existence is seen. Since the requirement of the members of the same species would be similar, such a struggle would be more intense amongst the members of the same species.

(v) **Variations :** They are rule of nature and proved to the beneficial for between existence.

(vi) **Natural selection :** Natural selection is the principle element of Darwin's theory. The principle by which the preservation of useful variations is brought about was called as **natural selection.**

16.14 (b) Merit of Darwinism :

(i) The major achievement of Darwin was to recognize one of the major factor in adaptation i.e. natural selection.

16.14 (c) Demerits of Darwinism :

(i) In Darwin's natural selection principle the death of the unit and the survival of the fittest was conceived.

(ii) Darwin's also believed that the natural selection operates on variations but he did not consider the possibility of the origin of new hereditary variations, which are really responsible for origin of species.

(iii) Darwin also did not distinguish between hereditary and environmental variations.

16.14 (d) Neo-Darwinism :

- It is a modified form of Darwinism, along with the recent researches of **Weisman, Mendel, Huxley, Gates, Devries** etc.
- They performed various experiments to remove objections against Darwin's Theory.
- **Neo - Darwinism comprises three important postulates :**

(i) Genetic variability : It means the variation that occur in the genetic constitution of an organism. They cold be of following types :

(A) Chromosomal aberrations [deletion, duplication, translocation and inversion]

(B) Chromosomal numbers [haploidy, polyploidy etc.]

(C) Gene mutation

(D) Hybridization

(ii) Natural selection : According to Neo - Darwinism the organism which is more adapted towards environment matures first and produces more progenies, as compaired to less adapted organism.

- It shows positive selection method.
- It can overcome environmental stress.
- It produces greater progeny than others

(iii) Reproductive isolation : it is the failure of interbreeding between the related groups of living organisms and is essential to prevent the dilution of differences between the genetically different species.

16.15 LAMARCKISM :

First theory of evolution was proposed by **Jean Baptiste de Lamarck** (1744 - 1829) Book **Philosophie Zoologiuie** (1809). The term **Biology** was given by **Lamarck & Treviranus.**

16.15 (a) Basic Concepts of Lamarckism :

(i) Internal Vital Forces : Some internal forces are present in all organisms. Bu the presence of these forces organisms have the tendency to increase the size of organs or entire body.

(ii) Effect of environment and new needs : Environment influences all types of organisms. Changing environment gives rise to new needs. New needs or desires produce new structures and change habits of the organism.

(iii) Use and disuse of organs : If an organ is constantly used, it would be better developed whereas disuse of organ results in its degeneration.

(vi) Inheritance of acquired characters : During the life time of an organism new characters develop due to internal vital forces, effect of environment, new needs and use and disuse of organs. These acquired characters are inherited from one generation to another. By continuous inheritance through many generations these acquired characters tend to make new generation quite different from its ancestors resulting in the formation of new species.

- **Examples in support of Lamarckism :**

(i) Long neck and large fore limbs of Giraffe.

(ii) Aquatic birds stretch their toes and developed webs.

(iii) Snakes have lost their legs.

(iv) Deer become a good runner by the development of strong limbs and streamlined body.

(v) Retractile claws of carnivorous animals.

16.16 (b) Criticism of Lamarckism :

(i) According to first concept organisms tends to increase their size but it is not a universally truth, e.g. Among angiosperms the trees seem to have been primitive and the shrubs, herbs and grasses evolved from trees but the size is reduced during evolution.

(ii) Second concept is false as we can't have a sprout wings wishing to fly like birds.

(iii) The third concept have some truth like the well developed biceps of black smith and less developed wings in flightless birds. But this concept also have many objection like the eyes of regular reader do not increase in size and power with increasing age, the constantly beating heart maintains a constant size through generations.

(iv) Forth concept is completely false because acquired characters are not inherited.

16.17 WEISMANN :

Weismann cut off tails of rats for about twenty two generations but there is no reduction in the size of the tail. On the basis of this experiment Weismann proposed the **theory of continuity of germplasm.**

16.17 (a) According to Weismann :

- Two types of mattes are present in organisms, sometoplasm and germplasm.
- Sometoplasm in somatic cells and germplasm in germinal cells.
- Sometoplasm dies with the death of an organism while germplasm is transferred into next generation.
- If any variation develops in germplasm it is inherited while if variation develops in sometoplasm it is not transmitted.

16.18 NEOLAMARCKISM :

Although Lamarckism remained controversial but some scientists gave following evidences in favour of Lamarckism they are called as **neo-lamarckians.** According to neolamarckism

environment affected the inheritance of acquired characters. According to it changing environment gives rise to some physical and chemical changes in organism which effect germplasm, and these acquired characters are definitely inherited.

DAILY PRACTICE PROBLEMS # 16

OBJECTIVE QUESTIONS

1. Which one of these is likely to have been absent in free form at the time of origin of life ?

(A) Oxygen (B) Hydrogen (C) Ammonia (D) Methane

2. The famous book **"Origin of Species"** was written by Charles Darwin in

(A) 1809 (B) 1859 (C) 1885 (D) 1871

3. Charles Darwin toured in a ship for five years it was

(A) Vikrant (B) Phillips (C) Alexander (D) Beagle

4. The term evolution in Biology means that

(A) fossils are old (B) life began in Sea

(C) living things constantly change (D) none of the above

5. The theory of Natural selection of Darwin to explain organic evolution was based on

(A) modification in organs through used and disuse

(B) probability of reproduction, struggle for existence and survival of the fittest

(C) Inheritance of acquired characters

(D) appearance of sudden large variations, then inheritance and survival of those having these variations

6. Homologus structures have

(A) similar origin & dissimilar function (B) dissimilar origin but similar function

(C) structurally as well as functionally similar (D) normally non-functional

7. Analogous organs are those which are

(A) structurally similar (B) functionally similar

(C) structurally as well as functionally similar (D) normally non-functional

8. The idea of "Survival of fittest" was given by

(A) Darwin (B) Herbert Spencer (C) Lamarck (D) Devries

9. Evolution is the best defined by

(A) inheritance of acquired characters (B) descent by modifications

(C) spontaneous generation (D) struggle for existence

10. Which one is not a vestigial organ in man ?

(A) Vermiform appendix (B) Plica seminualris (C) Ear muscles (D) Epiglottis

11. Who wrote the "Origin of Species" ?

(A) G.J. Mendel (B) Lamarck (C) De-Vries (D) Charles Darwin

12. When as organ is used it will develop and it is not used, it weakens to become vestigial. Who could have said this theory ?

(A) Darwin (B) De-Vries (C) Lamarck (D) Mendel

13. Fossils are

(A) fovea in the retina of vertebrate eye (B) remains of organisms presents in the rocks

(C) the fossa present in the bones (D) foramens through which nerves pass

14. An experiment to prove that organic compounds were the basis of life, was performed by

(A) Oparin (B) Miller (C) Melvin (D) Fox

15. Connecting link between Reptiles and Birds is

(A) dimetrodon (B) dodo (C) archaeopteryx (D) sphenodon

16. According to the Neo-Darwinian theory which of the following is responsible for the origin of new species?

(A) Mutations (B) Useful variations

(C) Mutations together with natural selection (D) Hybridization.

17. Fossils are dated now by

(A) stratigraphic position (B) amount of calcium residue

(C) association with other animals (D) radioactive carbon contents

18. Nucleoprotein gave most probably the first sign of

(A) life (B) amino acid (C) soil (D) sugar

19. According to one of the most accepted theory the earth atmosphere before any life has originated consisted of water vapour, hydrogen, NH_3 and

(A) methane (B) nitrogen (C) oxygen (D) carbondioxide

20. Origin of life is due to

(A) spontaneous generation (B) God's will

(C) effect of sun rays on mud (D) chemical evolution

SUBJECTIVE QUESTIONS

SHORT ANSWER TYPE QUESTIONS

1. What are the different ways in which individuals with a particular trait may increase in a population ?

2. Why are traits acquired during the life-time of an individual not inherited ?

3. Why are the small numbers of surviving tigers are cause of worry from the point of view of genetics ?

LONG ANSWER TYPE QUESTIONS

4. Explain how sexual reproduction gives rise to more viable variations that asexual reproduction ? How does this affects the evolution of those organisms that reproduce sexually ?

5. How is the equal genetic contribution of male and female parents ensured in the progeny ?

6. Only variations that confer an advantage to an individual organism will survive in a population. Do you agree with this statement ? Why or why not ?

ANSWERS

DAILY PRACTIVE PROBLEMS # 16

Que.	1	2	3	4	5	6	7	8	9	10
Ans.	A	B	D	C	B	A	B	A	B	D
Que.	11	12	13	14	15	16	17	18	19	20
Ans.	D	C	B	B	C	C	D	A	A	D