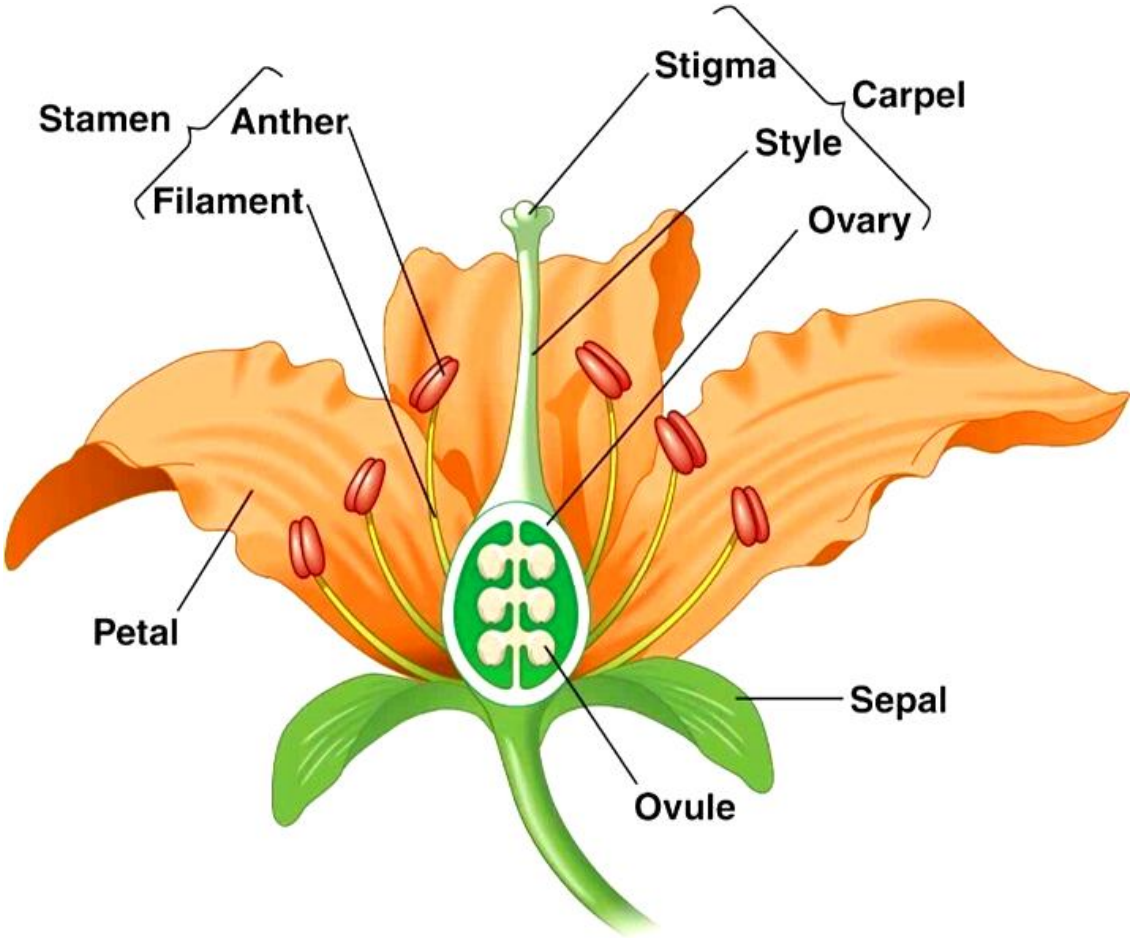
BIOLOGY

for NEET & BOARD



REPRODUCTION IN ORGANISM

Key Features

1. All-In One Study Material (For Boards/Medical/Olympiads).
2. Concise, Conceptual & Trick – Based Theory.
3. NTA Based Solved Multiple Choice Questions With Answers.

Reproduction In Organism

Chapter – **1**

India's First Trick Based Study Material

1 INTRODUCTION

1. Life span can be defined as the period from birth to the natural death of an organism.
2. It can vary from as short as few days to as long as a number of years.
3. It will be a misconcept to say that smaller organisms have shorter life span and larger organisms have longer life span.
4. **Maximum Life Span** is the maximum number of years survived or the greatest age reached by any member of a species.
5. **The average life span means,** the average number of years survived or age reached by members of a population.
6. **Life expectancy,** the number of years an individual can expect to live, is based on average life spans.
7. **The maximum life span of wild animals is very difficult to estimate** because signs of senility, or extreme old age are seldom seen in the wild.
8. Animals living under natural conditions rarely approach their maximum possible age because of *very* high death rates due to infant mortality, diseases, predators, bad weather, accidents or competition for food and shelter.
9. Limited life span means death of *every* individual organism is inevitable i.e. all individual are mortal except single celled organisms.
10. The limited life span, mortality of organisms, a variety of plant and animal species are well maintained on earth through the process –**reproduction.**
11. Reproduction ensures the continuity of the different species.

- Approximate life span of some organisms are as follows :

S.No.	Plant	Life Span
1.	Rise	3-4 months
2.	Rose	5-7 years
3.	Banana	25 years
4.	Mango	200 years
5.	Banyan	200-300 years
6.	Peepal	2000-3000 years
7.	*Sequoia*	3000-4000 years

S.No.	Animal	Life Span
1.	Butter fly	1-2 weeks
2.	Fruit fly	30 days
3.	Dog	20-30 years
4.	Crocodile	60 years
5.	Horse	60 years
6.	Elephant	60-90 years
7.	Tortoise	100-150 years

2 REPRODUCTION

Reproduction : Reproduction is the ability of living organism to produce a new generation of living individuals similar to themselves.

Basic features of reproduction : All organisms reproduce. Modes of reproduction vary in different organisms. However, all modes have certain common basic features. These are

(i) Replication of DNA. This is the molecular basis of reproduction.

(ii) Cell division, only mitotic, or both mitotic and meiotic. This is cytological basis of reproduction.

(iii) Formation of reproductive bodies or units.

(iv) Development of reproductive bodies into offspring.

Types of reproduction : These are of two main types

(i) Asexual (Non-gametic) (ii) Sexual (gametic)

(i) **Asexual reproduction**

(a) **Definition :** Production of offspring by a single parent without the formation and fusion of gametes is called asexual reproduction. The young one receives all its genes from one parent.

- A sexual reproduction is also known as agamogenesis or agamogeny.
- It involves only mitotic cell divisions, and also termed somatogenic reproduction.
- Asexual reproduction produces identical offspring commonly referred to as a clone. Today, the scientists have been able to produce clones of multicellular animals (e.g., boar calf names as Frosty, and Finn Dorset lamb named as the famous Dolly) artificially in the laboratory.

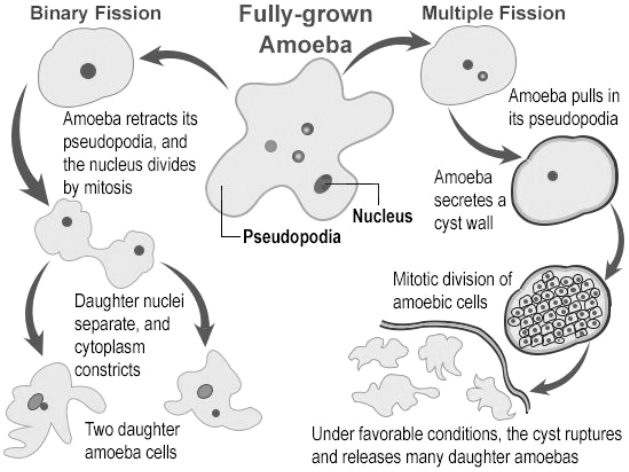
(b) **Occurrence :** Asexual reproduction occurs in protozoans and some lower animals such as sponges, coelentrates, certain worms and tunicates. It is absent among the higher non-vertibrates and all vertibrates.

(c) **Types :** Asexual reproduction takes place in five principal ways :

(1) **Binary fission :** Binary fission is the division of the parent into two small, nearly equalized daughter individuals. Examples – Protozoans (Amoeba, Euglena etc.) Bacteria and Planarians.

Modes of binary fission : In Binary fission, the nucleus divides first and the cytoplasm next. Subsequently, the mother cell splits into two equal sized daughter halves or cells. There are three modes of binary fission.

(i) **Simple binary fission :** If the plane of cytoplasmic division passes through any direction, the fission is called simple fission. Example – Amoeba.



(ii) **Transverse binary fission :** If the plane of cytoplasmic division concides with the transverse axis of the individual, the fission is termed transverse binary division. Example – Paramoecium and Planaria.

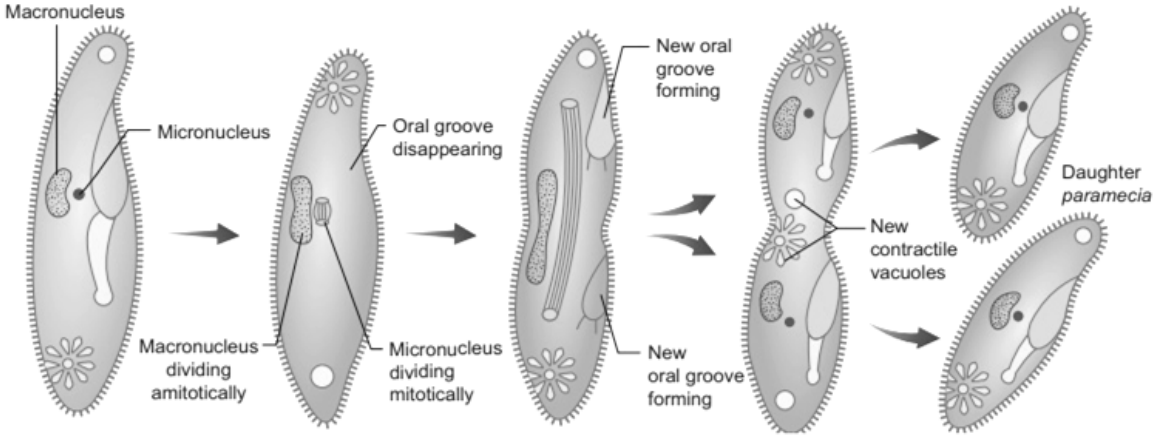


Fig. – Transverse binary fission in paramecium

(iii) **Longitudinal binary fission :** It the plane of cytoplasmic division concides with the longitudinal axis of the individual. This kind of fission is designated as longitudinal binary fission. Example – Euglena and vorticella.

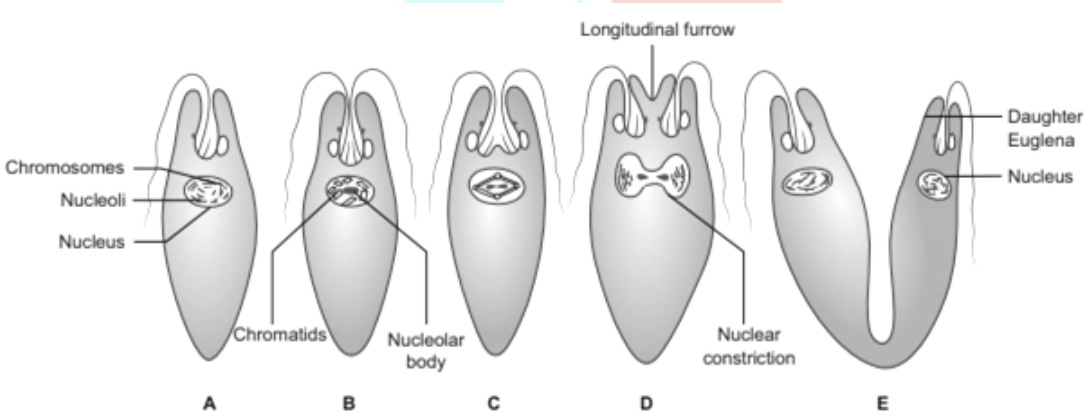


Fig. – Longitudinal binary fission in euglena

Binary fission involves mitotis only and consequently, the resultant offspring's are genetically identical to the parent and each other.

(2) **Multiple fission :** Multiple fission is the division of the parent into many small daughter individuals simultaneously. Examples – Multiple fission occurs in many protozoans such as Plasmodium, Amoeba and Monocytis.

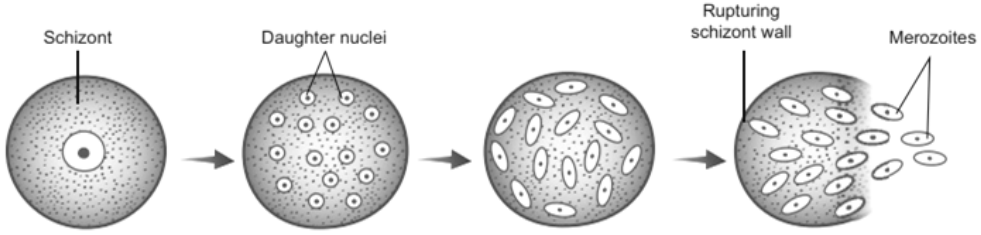


Fig. – Multiple fission of malarial parasite in RBC of man

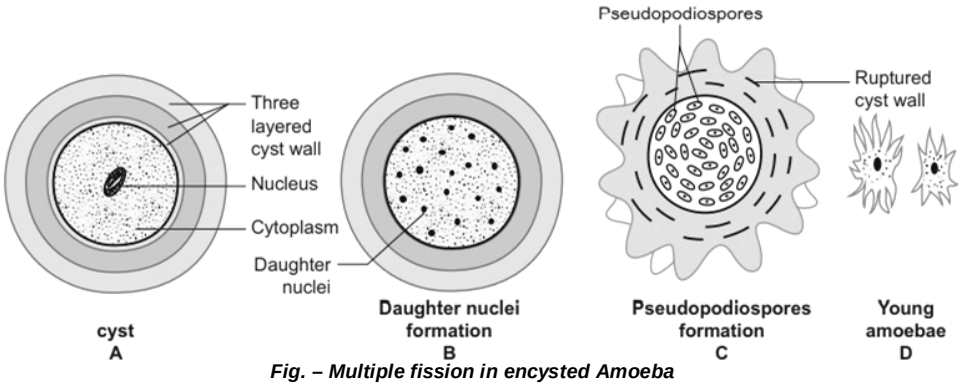


Fig. – Multiple fission in encysted Amoeba

Mode of multiple fission : Sometimes, the nucleus divides several times by amitosis to produce many nuclei, without involving any cytokinesis. Later, each nucleus gathers a small amount of cytoplasm around it and the mother individual splits into many tiny daughter cells.

In course of time, each of these daughter cells starts a free life and transforms into an adult individuals. This kind of fission is called multiple fission.

(i) **Encystation :** In response to unfavourable living condition, an Amoeba withdraws its pseudopodia and secretes a three-layered hard covering or cyst around itself. This phenomenon is termed as encystation.

(ii) **Sporulation :** During favourable condition, the encysted Amoeba divides by multiple fission and produces many minute amoebae or pseudopodiospores; the cyst wall burst out, and the spores are liberated in the surrounding medium to grow up into many amoebae. This phenomenon is known as sporulation.

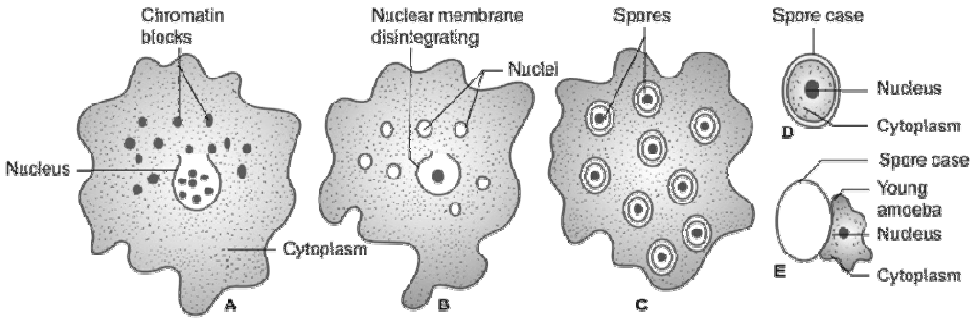


Fig: Sporulation in *Amoeba*

(iii) **Schizogony :** It is a type of multiple fission present in plasmodium. Schizogonies are of two type. Liver schizogony and blood schizogony.

In some metazoan animals, a special type of transverse fission called **strobilation** occurs. In the process of strobilation, several transverse fissions occur simultaneously giving rise to a number of individuals which often do not separate immediately from each other e.g. *Aurelia*.

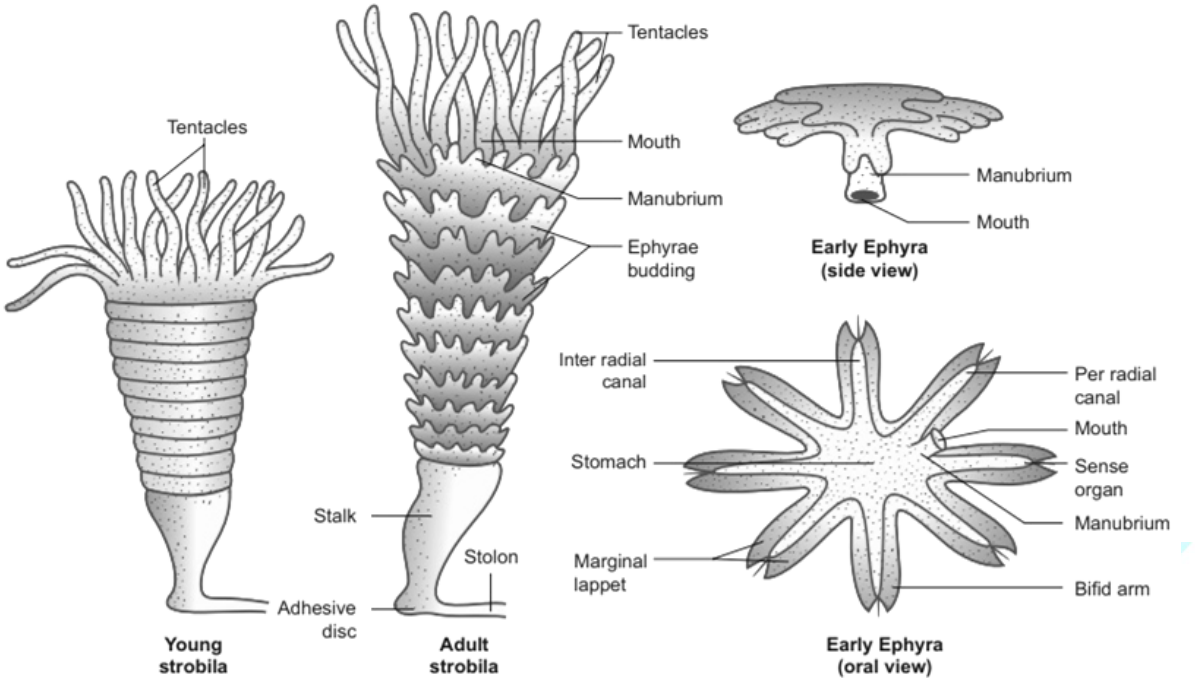


Fig: Strobilation in *Aurelia*

(3) **Plasmotomy :** Plasmotomy is the division of a multinucleate protozoan into several small, multinucleate daughters without nuclear division. The daughters grow and regain the normal number of nuclei by nuclear divisions. The daughters grow and regain the normal number of nuclei by nuclear division. It takes place in Opalina and Pelomyxa.

(4) **Budding :** Formation of a daughter individual from a small projection, the bud, arising on the parent body is called budding. It is a common method of asexual reproduction. In budding new individual form by mitosis. Examples – Budding occurs in some protozoans and certain lower animals such as sponges (Scypha), coelenterates (Hydra), annelids (chaetopterus) and tunicates (Salpa).

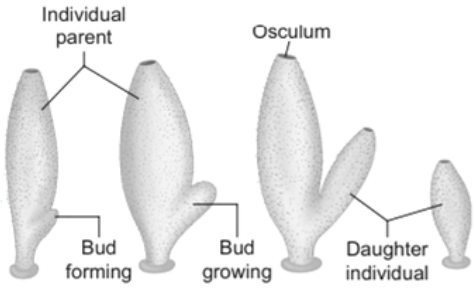


Fig: Budding in *Leucosolenia* (Sponge)

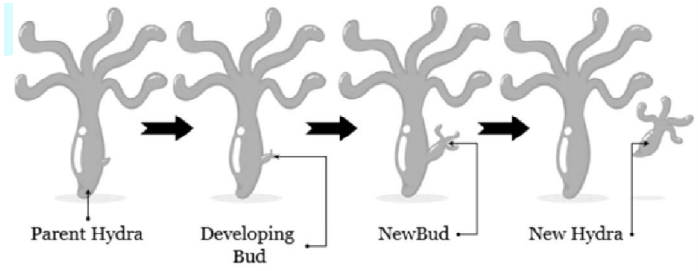


Fig: Budding in *Hydra*

Types of budding : There are two types of budding

(i) **Exogenous or External budding :** Initially, a small outgrowth of the parent's body develops into a miniature individual. It then separates from the mother to lead a free life. This type of budding is recognised as exogenous budding. Example – Hydra.

(ii) **Endogenous or Internal budding :** In fresh water sponges (*e.g.* – Spongilla) and marine sponge (*e.g.* – Sycon), the parent individual releases a specialised mass of cells enclosed in a common opaque envelope, called the gemmule, on germination. Each gemmule gives rise to an

offspring gemmules are thought to be internal buds. This type of budding recognised as endogenous budding. Example – Sycon and Spongilla.

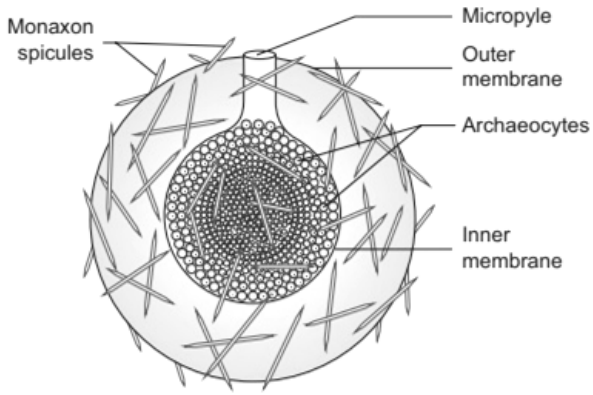


Fig. – A gemmule in sponges

(5) **Fragmentation :** It is the breaking up of an animal's body into two or more pieces, each of which grows into a new individual. Examples – It occurs in the flatworm, microstomum.

(d) **Special asexual reproductive bodies :** Archeoocytes of sponges are totipotent cells. They take part in the formation of gemmules. Gemmules form new sponges.

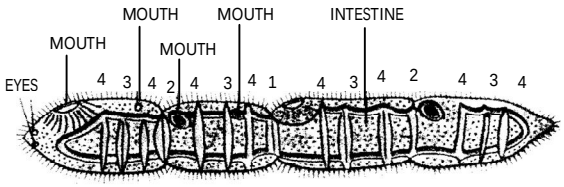


Fig. – Fragmentation in microstomum (a flatworm)

(6) **Spores:** Members of the kingdom fungi and simple plants such as algae reproduce through special asexual reproductive structure. The most commonly produced structures are **conidia** and **zoospores.**

ZOOSPORES

(i) These are motile and flagellated spores produced inside the zoosporangia under favourable conditions.

Fig: Zoospores in *Chlamydomonas*

(ii) In *Chlamydomonas(n)*, the protoplast of cell divides to form 8-16 zoospores. They are pyramid shaped and anteriorly biflagellated, resembling the parent cell. The parent cell wall breaks and the zoospores are liberated in water. They enlarge and behave as adult individuals.

(iii) *Zoospores are also produced in the asexual life cycle of* Achlya, Saprolegnia, Phytophthora *and* Ulothrix.

(iv) Zoospores of *Cladophora glomerata* are diploid

CONIDIA

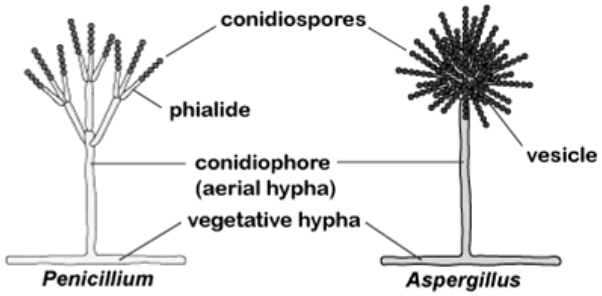
(i) In *Penicillium,* these spores are produced at the tips of special hyphal branches, called **conidiophores.**

(ii) There are two types of conidiophores :

a. Unbranched/monoverticillate

b. Branched/biverticillate

(iii) The branches of conidiophores are called **rami** and branches of rami are called **metulae.** Each metula bears 2-6 flask shaped structures called **sterigmata (phialides).** Each sterigma produces a chain of conidia.



(iv) Features of Conidia:

a. Pigmented

b. Uni or multinucleated

c. The conidia in the chain are arranged in basipetal manner.

(e) **Reproductive units in asexual reproduction :** Reproductive units vary in different forms of asexual reproduction. These are entire parent bodies in binary and multiple fission's and are small parts of parent body in budding and fragmentation. An asexual reproductive unit is called blastos.

(f) **Characteristics of asexual reproduction :** All forms of asexual reproduction have certain common basic features. These are under –

(1) A single parent produces offspring, that is, asexual reproduction is uniparental.

(2) Gametes are not formed.

(3) Cell divisions are only mitotic.

(4) The new individuals formed are usually genetically identical to the parent. Variability, if it occurs, is restricted to mutation only.

(5) Multiplication occurs rapidly.

(6) The offspring are often formed in large numbers near the parent.

(g) **Significance of asexual reproduction :** Asexual reproduction brings multiplication of the species only. It does not play a role in evolution as no variation is introduced into the new individuals formed by it. Asexual reproduction is theoretically most advantageous in stable, favourable environment because it perpetuates successful genotypes precisely.

(a) Vegetative Reproduction

(i) Vegetative reproduction does not involve meiosis and fusion of gametes, therefore it is considered ' as a type of asexual reproduction .

(ii) New plants or individuals are produced from vegetative parts of plants and newly formed

individuals are genetically identical to the parent plant.

(iii) It is common method of reproduction in the flowering plants. There are two types of vegetative reproduction.

I. Natural Methods of Vegetative Reproduction:

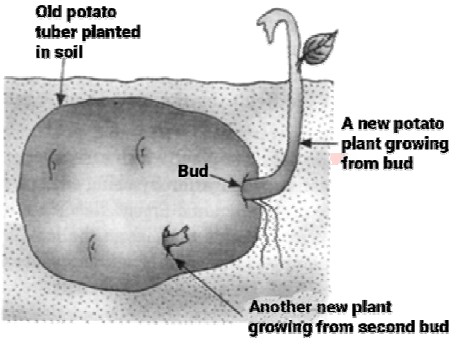
- These are methods of plant multiplication occurring naturally in which a somatic part of the plant detaches from the body of the mother and develops into a new independent plant under suitable environmental conditions.
- The detachable somatic part that functions in vegetative propagation is called **vegetative propagule.**
- It carries one or more buds. Natural buds occur over the nodes of the stem. When placed in contact with damp soil, the buds sprout, producing roots and new plants.
- This potential is exploited by farmers, *e.g.*, tubers of potato, rhizome of banana and ginger, bulbs, runners, offsets, stolons, aerial stems etc.
- Some propagules carry adventitious buds, *e.g.*, normal and storage roots, leaves. It occurs by following means:

STEM

Underground stems

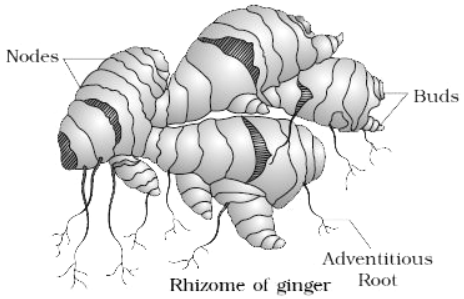
- Different types of underground stems like tuber, Germinating rhizome, bulb and corm can take part in Young shoot vegetative propagation.
- A portion of underground stem bearing bud Roots forms a new plant

(i) **Tuber :** It is terminal portion of underground stem branch which is swollen on account of accumulation of food. *e.g.,* Potato, Artichoke



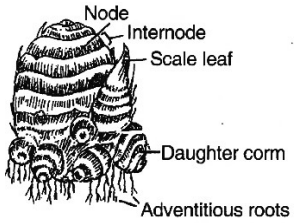
Eye of Potato

(ii) **Rhizome:** It grows obliquely or horizontally under soil surface. It is well branched and bears nodes, internodes, buds and scale leaves. *e.g.,* Banana, Turmeric, *Aspidium, Adiantum,* Ginger.



(iii) **Bulb:** Stem is unbranched, highly reduced and disc shaped. The bud is surrounded by many concentric scale leaves. Leaf bases of inner ones are fleshy and edible and outer ones are dry known as **tunic**. *e.g.,* Onion, Garlic, *Narcissus*

(iv) **Corm:** It grows vertically beneath the soil surface. It bears nodes, internodes, buds and scale leaves. *e.g., Colocasia, Gladiolus, Freesia., Crocus, Amorphophallus*



Corm of *Colocasia*

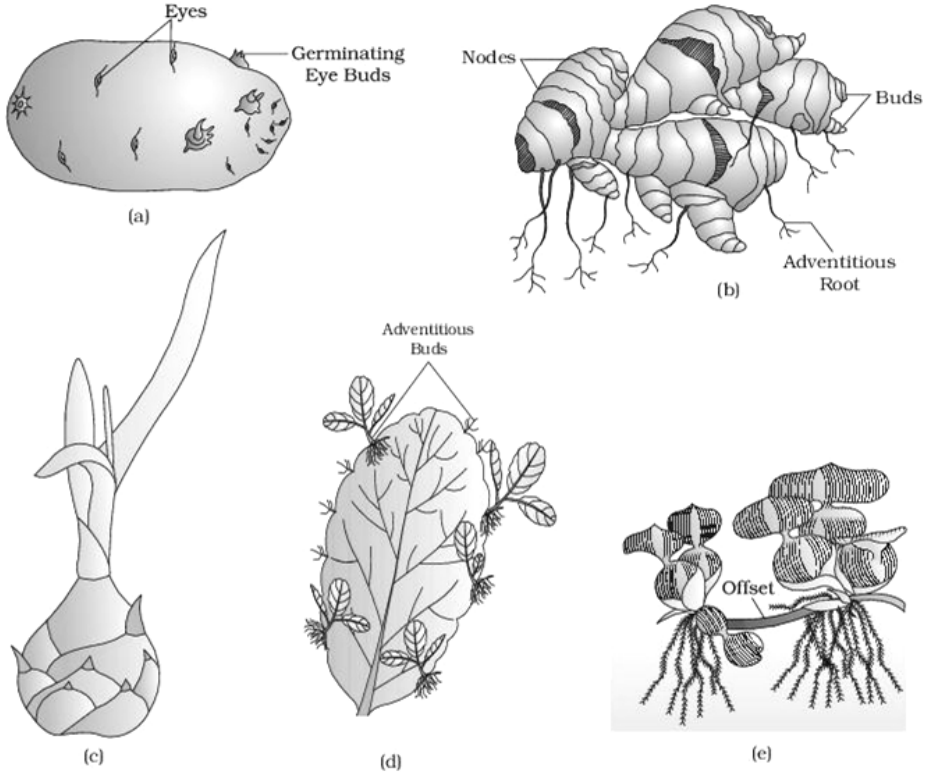
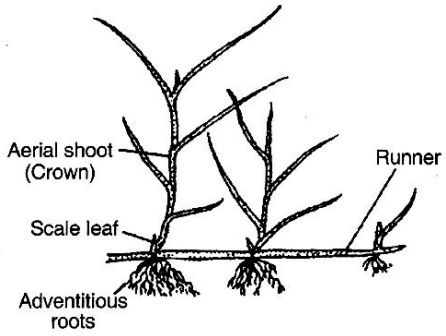


Fig: Vegetative propagules in Angiosperms: (a) Eyes of potato; (b) Rhizome of Ginger; (c) Bulbil of Agave; (d) Leaf buds of Bryophyllum; (e) Offset of water hyacinth

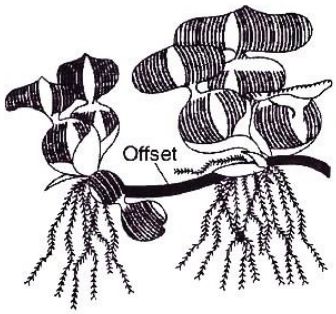
(1) *Creeping stems:*

(i) **Runner:** It is elongated, prostrate, sub-aerial branch with long internodes and roots at nodes. *e.g.,* Grasses



Runner of grass

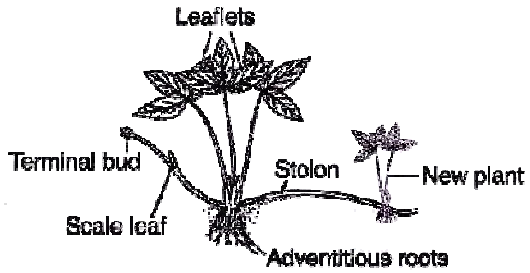
(ii) **Offset:** Short horizontal branch which is one internode long and produces a cluster of leaves above and the cluster of roots below is called **offset**. *e.g., Eichhornia* (Water hyacinth), *Pistia.*



Water hyacinth

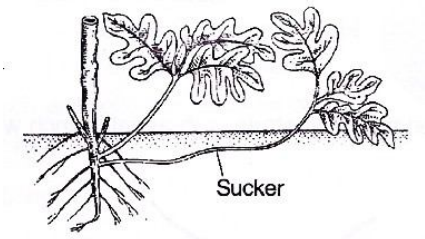
Water hyacinth or 'terror of Bengal' was introduced in Bengal because of its beautiful flowers and shape of leaves. However, it turned out to be highly invasive aquatic weed that not only spread to all water bodies of Bengal but also throughout India. It drains oxygen from the water, which leads to death of fishes and other animals. It is very difficult to get rid off them since it can propagate vegetatively by offset at a phenomenal rate and spread all over the water body in a short period of time.

(iii) **Stolon** : It is subterranean long lateral branch arising from base of stem. It first grows obliquely upward and then bends down to the ground surface.
e.g., Strawberry, *Vallisneria* Leaflets



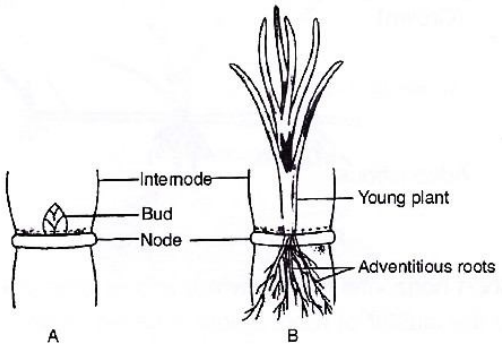
Stolon of Strawberry

(iv) **Sucker :** It arises by axillary bud of underground part of stem. This lateral branch creeps below the soil surface, grows obliquely upward and produces new shoot.
e.g., Chrysanthemum, Pineapple, Banana



Sucker in *Chrysanthemum*

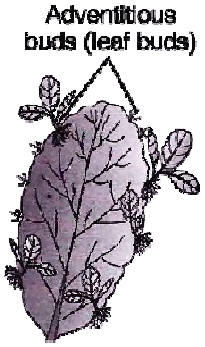
(2) Aerial shoots : Each segment of stem having at least one node can form a new plant.



Propagation from aerial shoot in Sugarcane

e.g., Sugarcane, *Opuntia*

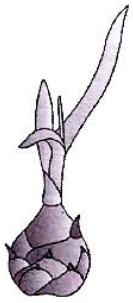
(3) Leaves: Leaves of several plants having adventitious buds help in vegetative reproduction. In *Bryophyllum* adventitious buds arise from the notches present at margins of leaves.



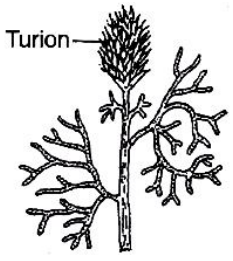
Bryophyllum

e.g., Adiantum (walking fern), *Begonia, Streptocarpus, Saintpaulia and Kalanchoe.*

(4) **Bulbils:** These are fleshy buds which produce new plant. *e.g., Agave, Oxalis, Ananas, Dioscorea*, Lily, *Chlorophytum*


Bulbil of *Agave*

(5) **Turions :** Fleshy buds in aquatic plants helping in perennation, *e.g., Potamogeton, Utricularia.*



Utricularia showing turion

ROOTS

(i) Both tap roots and adventitious roots takes part in vegetative reproduction due to the presence of bud, known as **radicle bud**.

(ii) Adventitious buds on root detaches and gives rise to new plant.

II. *Artificial Methods of Vegetative Reproduction:*

- Artificial methods are man-made special techniques in which, part of somatic body of a plant is made to develop into new independent plant.
- Artificial methods are used to propagate desired varieties according to human requirements, Rainy and spring seasons are the best periods for vegetative propagation.
- The various horticultural methods of vegetative propagation are as follows:

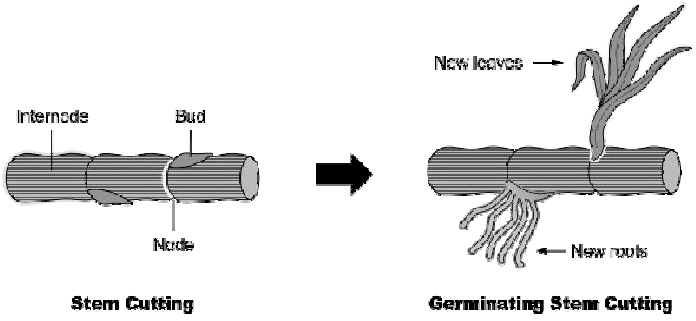
1. *Cuttings:*

- Cuttings are cut pieces of stem, leaves and root which are planted in nurseries in natural polarised fashion, Pre-requisite to successful cutting is induction of rooting, For this, root promoting chemicals like IBA, NAA are used,

(i) *Stem Cuttings :*

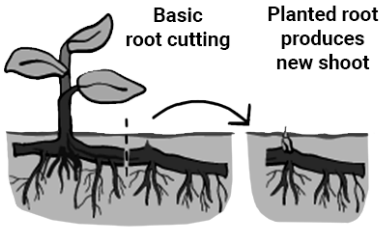
It is a common artificial method of plant propagation, 20-30 cm long pieces of one year old stems are cut and their lower ends are dipped in dilute auxin for several minutes before planting in the soil. The lower ends develop adventitious roots, Buds present over the exposed parts sprout and form the shoot system,

e,g., Rosa, Duranta, Citrus, Clerodendron, Thea, Bougainvillea, Croton and China rose



(ii) Leaf Cuttings: Snake plant *(Sansevieria)* can be propagated by leaf cuttings, Leaves are cut transversely into two or three parts and planted in vertical position in the soil. For successful leaf cutting, besides induction of rooting, formation of adventitious buds is also important

(iii) Root Cuttings : They are long pieces of roots which are used to artificially propagate new plants, **Ability to form adventitious roots and adventitious buds are pre-requisites.** Root cuttings are used in propagation of Lemon,



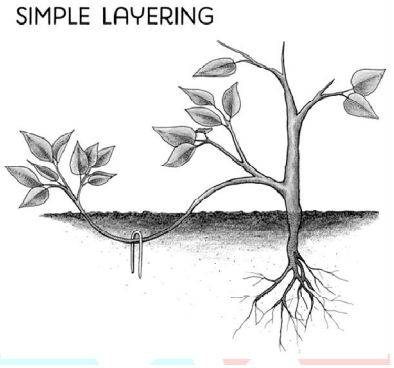
Tamarind, Blackberry and Raspberry.

2. *Layering:*

(i) It is a type of rooting-cutting method in which adventitious roots are induced to develop on a soft stem while it is still attached to the plant.

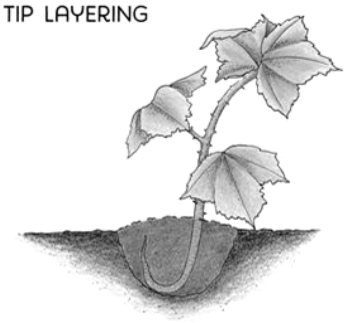
(ii) It is carried out on one year old basal shoot branches commonly during early spring or early rainy season.

(iii) A **soft basal branch** is defoliated in the middle where a small injury or cut is also given, like tongueing (oblique cut), notching (V-shaped cut), ringing (removal of a ring of bark). The injured defoliated part is pegged in the soil to develop adventitious roots. The pegged down branch of the plant is called **layer.** Later on as the roots develop, the layer is separated and planted.

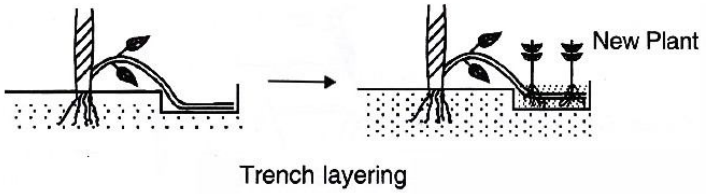


(iv) Layering is of following types:

(a) **Tip Layering** : A shoot is bent down in the soil in such a way that its basal end is slanting while the tip is upright. Soil is pressed. It induces root formation and later growth of shoot tip. *e.g.,* Blackberry, Raspberry.

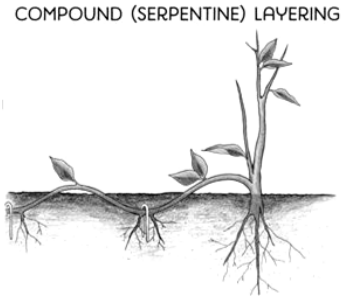


(b) **Trench Layering** : The basal branch is pegged in a horizontal position in a trench made in soil. It develops a number of vertical shoots. *e.g.,* Walnut, Mulberry.



Trench layering

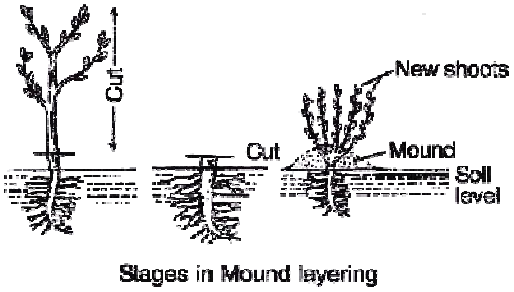
(c) **Serpentine Layering :** The basal branch is pegged at several places in soil at regular intervals, so as to form many plants. *e.g., Clematis*



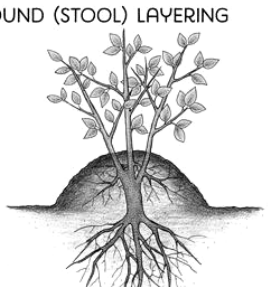
(d) *Mound (Stool) Layering*

The shoot is pruned and its lower part is covered by soil but the tip is kept outside the soil. When a number of new shoots develop, soil and saw dust are poured over the base to form a mound. Each shoot develops roots. Rooted shoots are separated and planted.

e.g., Currant, Gooseberry, Apple, Pear and Jasmine



Stages in Mound layering



(e) *Gootee (Air Layering)*

(i) It is an ancient horticultural technique for propagation of tropical and subtropical trees and shrubs where soft branches do not occur near the soil.

(ii) During early monsoon rains, 3-5 cm long ring of bark is removed from the basal region of a healthy and woody branch. It is covered by a thick plaster of **grafting clay.** Grafting clay is made of **1 part cow dung, 1 part finely cut hay or moss and two parts clay.** To it is added water and a small quantity of root promoting hormones like IAA, IBA or NAA. It is then wrapped in polythene. After 2-3 months, roots appear. The shoot is now cut below the covered part and used for planting.

e.g., Litchi, Pomegranate.

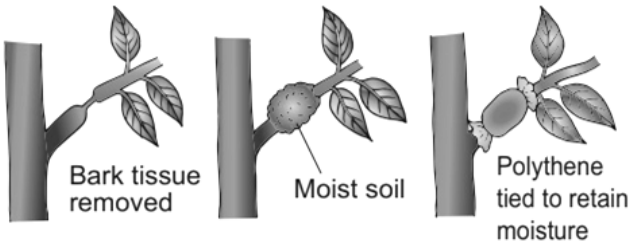


Fig: Air Layering

3. *Grafting:*

(i) Grafting is a technique of connecting two parts, usually a root system and a shoot system of two different plants in such a way that they unite and later develop as a composite plant.

(ii) It is used only in cambium containing eustelic plants.

(iii) A small shoot of plant with superior traits is employed. It is called **graft or scion.** It should have one to several buds. The root system of the other plant is allowed to remain intact. It is called **stock** (understock). The shoot of the stock is often cut 10-30 cm above the base of the root. Leaves and buds present over the stump of stock are removed.

(iv) In grafting, scion is fixed over the stock in a manner that cambia of the two come in contact. The union is covered with grafting wax. It is then tied with the help of a bandage, tape, rubber or nail. The buds of the stock are not allowed to sprout.

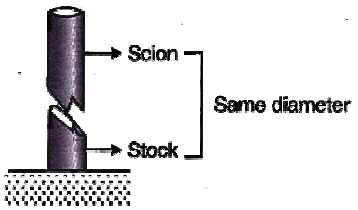
(v) They are removed as soon as they are noticed.

e.g., Mango, Apple, Pear, *Citrus*, Guava, Plum, Peach, Pine etc.

- The various types of grafting are as follows:

(a) *Tongue (Slice or Whip) Grafting*

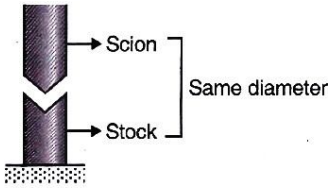
Oblique sloping cut or notch is given to both stock and scion. The two perfectly fit upon one another. They are tied together.



Tongue grafting

(b) *Wedge Grafting*

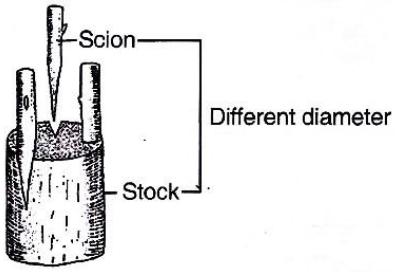
V-shaped notch is given to stock while wedge like cut is given to scion.



Wedge grafting

(c) *Crown Grafting*

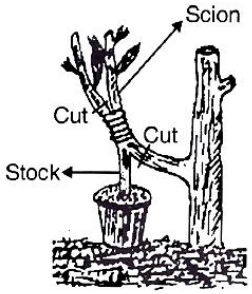
Many scions are selected and shaped at the base to form wedge. Many slits are formed on the sides of stock. Scions are inserted in the slits and are bandaged.



Crown grafting

(d) *Approach Grafting*

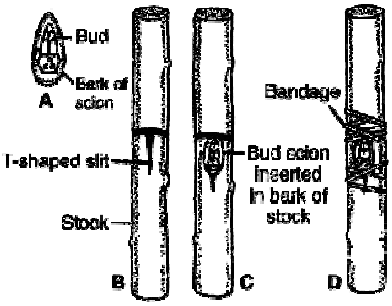
Two independently growing plants are brought together. The shoots of the two are given cuts at the same level for a distance of 2.5 -5.0 cm. The cuts are in the form of smooth **slices** of bark, **tongue shaped cuts** or deeper **vertical cuts.** In this grafting, the scion is cut below the graft while stock is cut above the graft after the establishment of union.



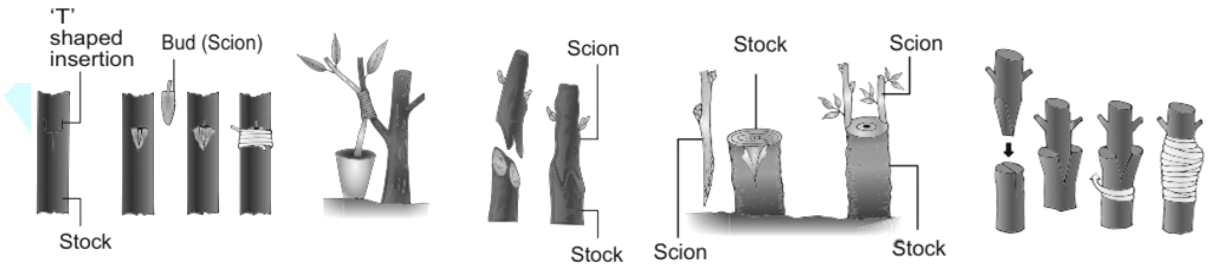
Approach grafting

(e) *Bud Grafting*

Scion is a bud with a small piece of bark and cambium. Stock is given a T-shaped cut. Bark is lifted to expose cambium. Bud is inserted and the bark is allowed to come back to its original position. Only the bud is exposed. The joint is treated with grafting wax and bandaged. Bud sprouts after 3-5 weeks. Bud grafting is commonly practised in apple, peach and rose.



Bud grafting



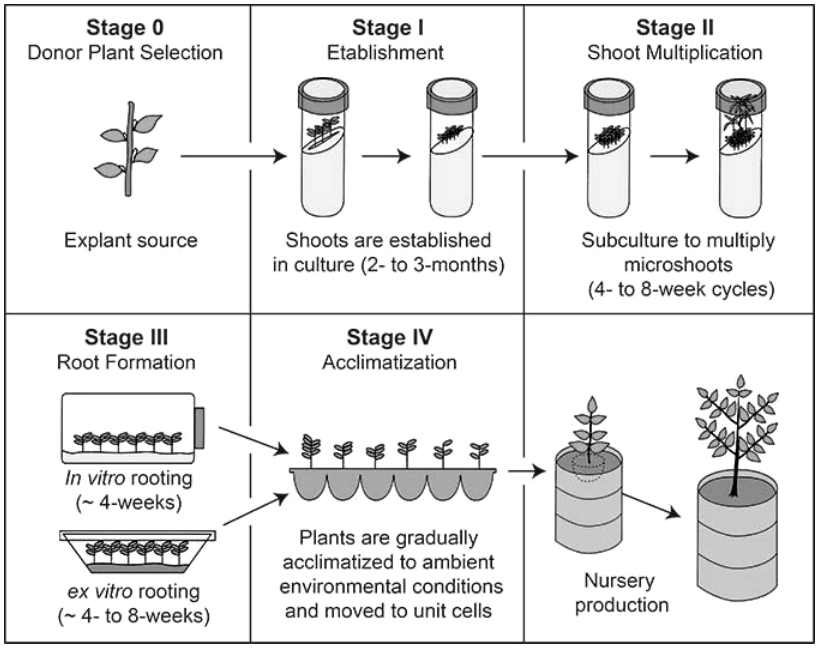
(i) Bud grafting (ii) Approach grafting (iii) Tongue grafting (iv) Crown grafting (v) Wedge grafting

Fig: Types of grafting

4. *Micropropagation:*

- Micropropagation is the raising of new plants from a small plant tissue with the help of tissue culture technique.
- **Tissue culture** is the technique of maintaining and growing cells, tissues, etc. and their

differentiation on artificial medium under aseptic conditions inside suitable containers.



(ii) **Sexual reproduction**

(a) **Definition :** It is the production of offspring usually by two parents, male and female. Involving four processes :

(1) Formation of special haploid cells, the gametes, by meosis. (Gametogenesis)

(2) Fusion of the gametes in pairs, forming diploid cells, the zygotes (Fertilization)

(3) Repeated mitotic divisions of zygotes to form embryos (Embryogenesis)

(4) Growth of Embryos into a new individuals (Development)

❖ Sexual reproduction is also called syngenesis.

Phases in Life Cycle

Three phases are there in the organism's life cycle.

1. Juvenile phase
2. Reproductive phase
3. Senescent phase

1. Juvenile phase/pre-reproductive phase

- During this phase organism will show growth so that it can attain certain maturity to perform the sexual reproduction
- This phase is known as **vegetative phase** in plants. It is of variable durations in different organisms.

2. Reproductive phase

- Reproductive organs develop and mature during this phase. In the higher plants, end of juvenile phase or onset of reproductive phase is easily marked.
- In the higher plants during this phase, there is formation of reproductive structures *i.e.*, flowers.
- The motto of this phase is to produce the offsprings which may be similar or dissimilar to parental generation. This phase is also of variable durations in different organisms.

- Based upon flowering and fruiting pattern there are two types of flowering plants, *i.e.,* monocarpic and polycarpic.

Monocarpic Plants :

- They are plants which flower only once in their life. After flowering, they produce fruits and die. All annuals *(e.g.,* Wheat, Rice, Marigold) and biennial plants *(e.g.,* Radish, Carrot, Henbane), are monocarpic.
- A few perennial plants are also monocarpic. Certain bamboo species *(e.g., Bambusa tulda, Meloeanna bambusoides)* live vegetatively for 50-100 years, flower and fruit abundantly and then die.
- *Strobilanthus kunthiana* (vern. Neelakurinji) flowers once in 12 years.
- The last time it flowered was September-October 2006. The flowering converted large hilly tracts of Kerala, Karnataka and Tamil Nadu into blue stretches that attracted a large number of tourists.

Polycarpic Plants :

- They are perennial plants which after reaching maturity, flower repeatedly at intervals, *e.g.,* Mango, Apple, Jackfruit, Grape vine, Orange.
- Very few perennial plants bear flowers throughout the year, *e.g.,* China rose (Shoe Flower). The period between two flowering phases is called **Interflowering period** which is used for building up resources and is, therefore, a recovery phase. It is not the juvenile phase but is part of the mature phase.

3. Senescent Phase:

- It is a post-reproductive phase. It involves structural and functional deterioration of body by accumulation of waste metabolites which ultimately leads to death.
- In both plants and animals, hormones are responsible for the transitions between three phases. Interaction between hormones and certain environmental factors regulate the reproductive processes and the associated behavioural expressions of organisms

EVENTS IN SEXUAL REPRODUCTION

- After attainment of maturity, all sexually reproducing organisms exhibit events and processes that have remarkable fundamental similarity, even though the structures associated with sexual reproduction are indeed very different.
- These sequential events may be grouped into three distinct stages, namely, the pre-fertilisation, fertilisation and the post-fertilisation events

1. *Pre-fertilization events*

These are events in sexual reproduction which occur prior to the process of fertilization. The two main prefertilization events are gametogenesis and gamete transfer.

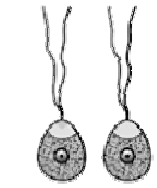
(a) Gametogenesis: It refers to the process of formation of gametes-male and female.

Categories of Gametes :

(i) Isogametes : When the fusing gametes are morphologically similar they are known as **isogametes** or **homogametes**.

e.g., (i) Algae: *Chlamydomonas debaryana, Ulothrix*

(ii) Fungi : *Synehytrium, Rhizopus*



Isogametes of
Cladophora (an alga)

(ii) Heterogametes: When the fusing gametes are morphologically distinct types, they are known as **heterogametes.** It is the feature of majority of sexually reproducing organisms.

e.g., (i) Algae: *Volvox, Chara, Fucus*

(ii) All Bryophytes, Pteridophytes, Gymnosperms and Angiosperms.

In such organisms, male gamete is called **antherozoid or sperm** and the female gamete is called **egg or ovum.**

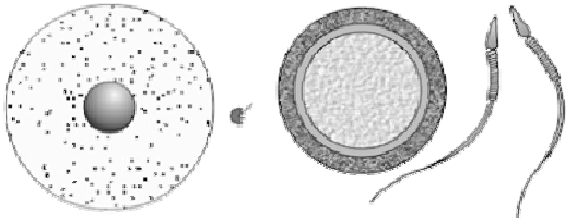


Fig. : (a) Heterogametes of *Fucus* (an alga);

(b) Heterogametes of *Homo sapiens* (Human beings)

Sexuality in organisms:

- Sexual reproduction in organisms generally involves the fusion of gametes from two different individuals. But this is not always true.
- Plants may have both male and female reproductive structures in the same plant (**bisexual**) or on different plants (**unisexual**).
- In several fungi and plants, terms such as **homothallic** and **monoecious** are used to denote the **bisexual condition** and **heterothallic** and **dioecious** are the terms used to **describe unisexual condition**.

A. Sexuality in animals

- The individuals of all species either male or female (unisexual)?
- Or are there species which possess both the reproductive organs (bisexual)?
- You probably can make a list of several unisexual animal species.
- **Earthworms**, **sponge, tapeworm and leech**, typical examples of **bisexual animals** that possess both male and female reproductive organs, are **hermaphrodites**.
- **Cockroach** is an example of a **unisexual species**.

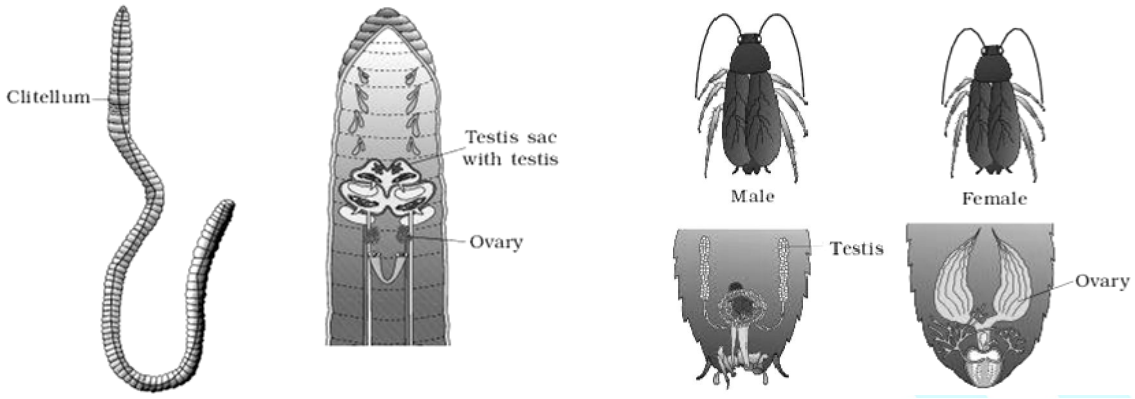


Fig: Bisexual animal (Earthworm) Unisexual animal (Cockroach)

Table: Chromosome numbers in meiocytes (diploid, 2n) and gametes (haploid, n) of some organisms.

Name of organism	Chromosome number in meiocyte (2n)	Chromosome number in gameter (n)
Fruit fly	8	4
House fly	12	6
Garden pea	14	7
Maize	20	10
Rice	24	12
Apple	34	17
Cat	42	21
Human beings	46	23
Potato	48	24
Dog	78	39
Sugarcane	80	40
Poa litorosa (grass)	266	133
Butterly	380	190
Ophioglossum (Adder's tongue fern)	1260	630

B. Sexuality in Plants

- In most of the lower sexually reproducing organisms, two fusing gametes are morphologically similar.
- If these gametes belong to the same parent then such organisms are called **homothallic,** *e.g.,* fungi *(Mucor mucedo).* When these gametes belong to different parents then these organisms are called **heterothallic.**

Higher Organisms:

- In higher plants there is well developed sex organs and there is clear distinction between male and female sex organs.
- Angiosperms possess flowers as reproductive structures. The male sex organ is called stamen and female sex organ is carpel or pistil.
- If male and female sex organs occur in the same flower then these plants are called **bisexual**, *e.g.,* China rose. If flowers possess only stamen or carpel then these plants are called **unisexual**.

- When male flower **(staminate)** and female flower **(pistillate)** are present on same plant body such plants are monoecious, *e.g.*, *Acalypha*, cucurbits, coconut and maize.
- However, if they are present on separate plant body then these plants are known as **dioecious,** *e.g.*, date palm, papaya and mulberry.
- In some of the lower plants also the monoecious and dioecious condition occur. For knowing this, we will study the sexuality in *Chara* and *Marchantia*.

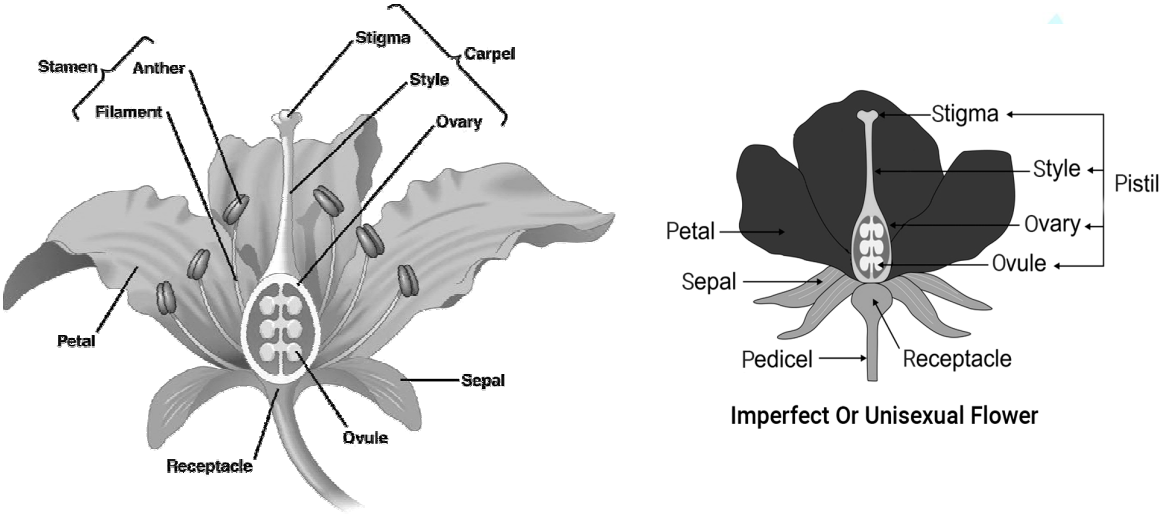


Fig: Bisexual flower (stamen and carpel present)

Sexual Reproduction in *Chara* and *Marchantia :*

- The *Chara* is a green alga. It is oogamous. The sex organs are highly specialised. Some workers prefer to call the male sex organ as **antheridium** and female as **oogonium,** while others did not favour this terminology.
- They call the male sex organ as **globule** and the female as **nucule** and this terminology is largely followed in *Chara*. These sex organs are **exceptionally multicelled and covered by jacket.**

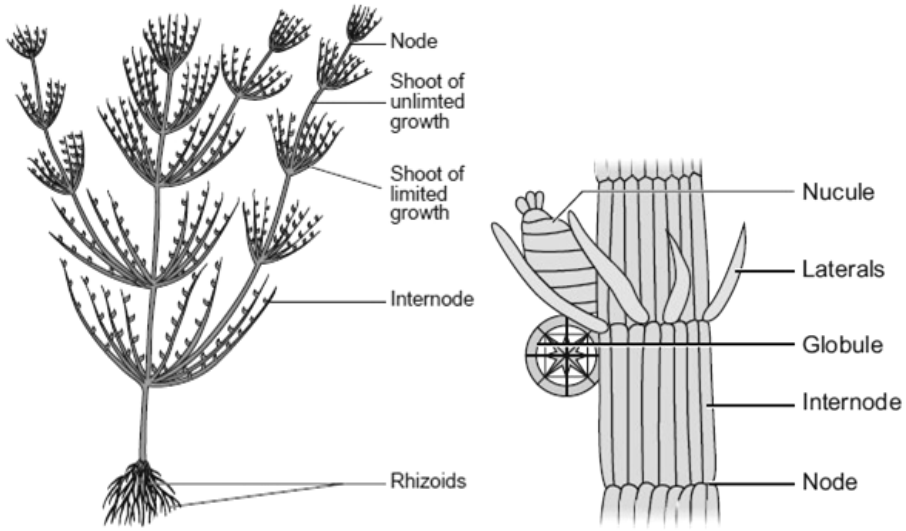


Fig: Chara habitat and sex organs

- The jacket of nucule is formed by **tube cells** and the jacket of globule is formed by **shield cells.** The nucule has a cap of 5 coronary cells.

- The sex organs are borne on the adaxial surface of the short lateral branch almost on each node. The nucule occupies an upper position than the globule.
- While most of the species of *Chara* are monoecious, *C. wallichii* is dioecious. The globule matures prior to nucule **(protandrous condition).**
- Each antheridium produces many band shaped, spirally coiled, biflagellate antherozoids. The oogonium contains a single egg. The egg is laden with starch and oil globules.
- In *Marchantia,* the archegonia are borne on special branches called **archegoniophores** or the **female receptacles**. The archegonia may be stalked or sessile.

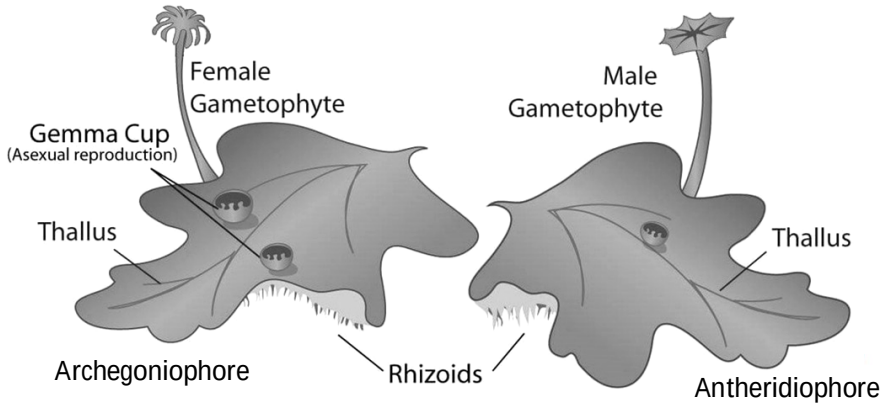


Fig: Dioecious plant (*Marchantia*)

Cell division during gamete formation

- Gametes are haploid though the parent plant body producing these gametes may be either haploid or diploid.
- A haploid parent produces the gametes by mitotic division however organisms having diploid body the gametes are formed through reductional division, *i.e.*, meiosis.
- In these organisms specialised cells called **meiocytes** or gamete mother cells undergo meiosis. At the end of meiosis only one set of chromosomes gets incorporated into each gamete. In seed plants, pollen grains are the carrier of male gametes and ovule has the egg

(b) Gamete transfer :

- After the formation of male and female gametes, compatible gametes must be physically brought together to facilitate fusion (fertilisation or syngamy).
- In few fungi and algae, both types of gametes are motile. In heterogametic condition, the female gamete is non motile. So there is a need of a medium through which the male gametes move.
- Water is the medium for gamete transfer in algae, bryophytes and pteridophytes. A large number of the male gametes however, fail to reach the female gametes.
- To compensate this loss of gametes, the number of male gametes produced in several thousand times the number of female gametes produced.

2. FERTILISATION

- The most vital event of sexual reproduction is the fusion of gametes. This process is called syngamy or fertilisation which results in the formation of a diploid zygote.
- Syngamy can occur in external medium as well as inside the body of organism.
- On this basis syngamy can be distinguished into two types :

(a) External fertilisation :

- Syngamy occurs outside the body of organism in external medium (water). It is shown by majority of aquatic organisms like most of algae, fishes as well as amphibians.
- Organisms exhibiting external fertilisation show great synchrony between the sexes and release a large number of gametes into the surrounding medium in order to enhance the chances of syngamy.
- The disadvantage associated with it is that the offsprings are extremely vulnerable to predators.

(b) Internal fertilisation:

- Syngamy occurs Inside the body of organisms. It is present in majority of plants like bryophytes, pteridophytes, gymnosperms and angiosperms.
- It occurs in few algae like *Spirogyra*. In all these organisms egg is formed inside the female body where syngamy occurs.
- The male gamete is motile and has to reach the egg in order to fuse it. In order to enhance the chances of syngamy large number of sperms are produced in these organisms and to compensate for this there is significant reduction in number of eggs produced.

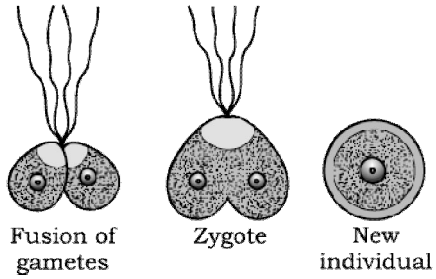


Fig: Homogametic contact in an algae

3. POST-FERTILISATION EVENTS

Events in sexual reproduction after the formation of zygote are called **post-fertilisation events**.

Zygote :

- It is the first cell of the new generation in all sexually reproducing organisms. Zygote is always diploid.
- It is formed in the external aquatic medium in those organisms which perform external fertilization. Zygote is produced inside the body in cases where fertilization is internal.
- Zygote is a **vital link** between two successive generations. It ensures the continuity of race from generation to generation.
- The body of all multicellular organisms develops from the single-celled zygote. All the cells of the body, therefore, contain the same genetic traits as present in the zygote.

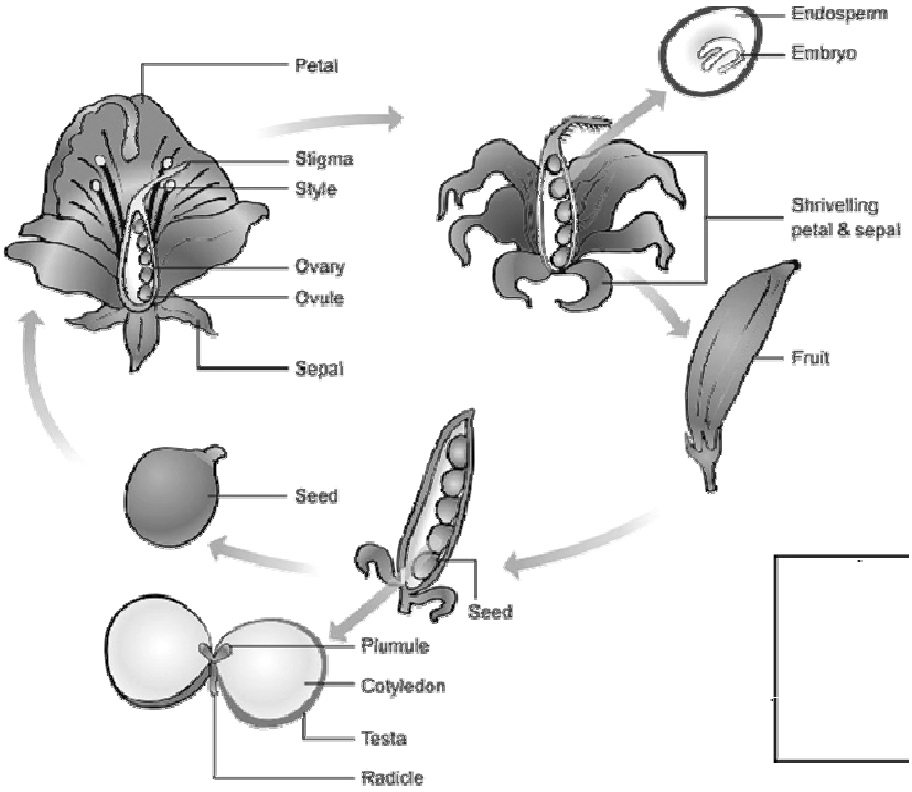


Fig: Post-fertilization changes in the flower of an angiosperms

Embryogenesis

A. In Plants :

- Embryogenesis is the process of development of embryo from zygote. Embryo is a multicellular stage in the life cycle of a plant or animal prior to formation of an independent individual.
- In embryogenesis, the zygote undergoes repeated cell divisions through mitosis. The divisions help in growth of the embryo.
- Cells undergo differentiation attaining specific shape, size and function. Cell differentiation occurs at specific locations resulting in production of different tissues, organs and organ systems.
- Development of different external and internal structures is called **morphogenesis.** In flowering plants, zygote develops into **embryo.**
- The food for development of embryo comes from a special tissue known as **endosperm**. Ultimately, the fertilized ovule matures into a **seed.**
- A number of seeds develop in an ovary depending upon the number of ovules. Meanwhile, wall of the ovary also proliferates. It produces pericarp. The pericarp can be dry or fleshy.
- The ripened ovary with pericarp and seeds is called **fruit**. As the fruit begins to develop, sepals, petals, stamens, style and stigma normally sheds. After dispersal, the seeds, upon reaching suitable substratum germinate and form new plants.

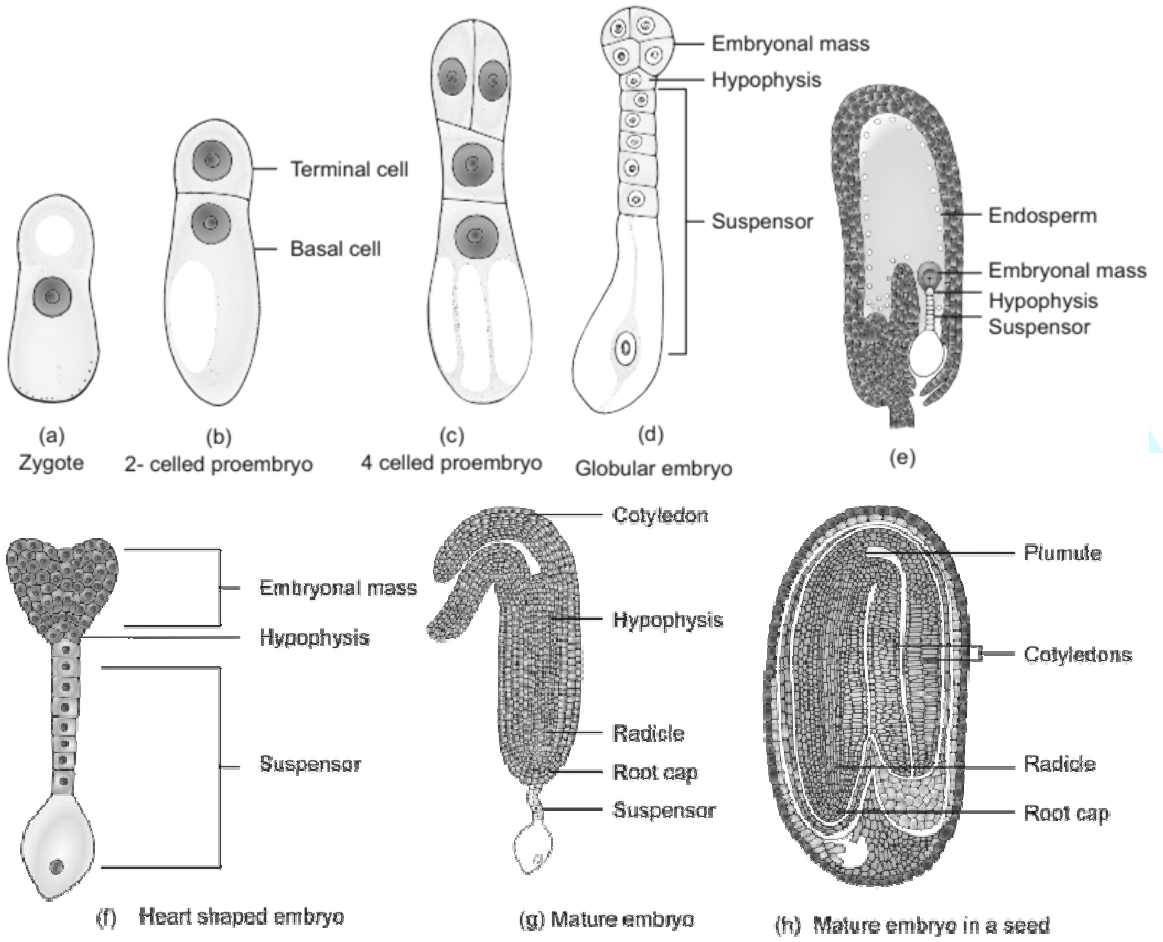


Fig: Development of Dicot embryo (*Capsella bursa-pastoris*)

During the development, the two cells of the basal cell undergoes several transverse division to form a six to ten celled suspensor. The embryo at this stage become globular and the suspensor helps to push the embryo deep into the endosperm. The uppermost cell of the suspensor enlarge to form a haustorium. The lowermost cell of the suspensor is called hypophysis. A transverse division and two vertical division right angle to each other of hypophysis results in the formation of eight cells. The eight cells are arranged in two tiers of four cells each The upper tier give rise to root cap and epidermis. At this stage embryo proper appears heart shaped, cell divisions in the hypocotyl and cotyledon regions of the embryo proper results in elongation. Further development results in curved horse shoe shaped embryo in the embryo sac. The mature embryo has a radicle, two cotyledons and a plumule

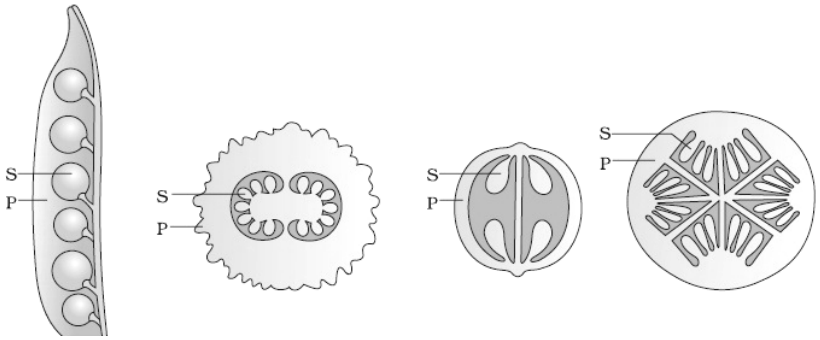


Fig. : A few kinds of fruits showing seeds (S) and protective pericarp (P)

B. In Animals :

- Animals are categorised into **oviparous** and **viviparous** based on whether the development of the zygote take place outside the body of the female parent or inside.
- Whether they lay fertilised/unfertilised eggs or give birth to young ones.
- In **oviparous** animals like reptiles and birds, the fertilised eggs covered by hard **calcareous shell** are laid in a safe place in the **environment;** after a period of incubation young ones hatch out.
- On the other hand, in **viviparous** animals (majority of mammals including human beings), the zygote develops into a young one inside the body of the female organism.
- After attaining a certain stage of growth, the young ones are delivered out of the body of the female organism.
- Because of proper embryonic care and protection, the chances of survival of young ones is greater in viviparous organisms.

(b) **Occurrence :** Sexual reproduction occurs nearly in all mammals, including those which reproduce asexually. Some protozoans, such as Amoeba, Euglena lack sexual reproduction. In most and female, and the difference between them is determined genetically. In sexual reproduction offsprings resemble the parent.

(c) **Types :** Sexual reproduction is of two main types –

(1) Amphigony (2) Parthinogenesis

(1) **Amphigony :** It involves the complete and permanent fusion of two gametes from differents or from the same parent to form a composite cells, the zygote. It is further of two kinds :

(i) Syngamy (ii) Conjugation

(i) **Syngamy :** It involves the fusion of two entire gametes to form a zygote. It is further of two types with regard to the source of fusing gametes :

(a) **Endogamy :** It involves self-fertilization, *i.e.,* the fusion of two gametes of the same parent. It is, thus uniparental. It is not common. It is found in Taenia, a tapeworm. Tapeworm is a bisexual (hermaphrodite, monoecious) animal.

(b) **Exogamy :** It involves cross-fertilization, *i.e.,* the fusion of two gametes formed by different parents. It is, thus, biparental. It is very common. It is found in frog, rabbit and man. Syngamy is also of two kinds with regard to the structure of the fusing gametes :

(a) **Isogamy :** The fusing gametes are similar morphologically as in Monocytis, a protozoans. Such gametes are known as isogametes, and their fusion is termed isogamy. Although the isogametes are similar in structure, they have behavioural differences. The gametes produced by one parent do not fuse with each other.

(b) **Anisogamy or Heterogamy :** The fusing gametes are different in form, size structure and behaviour as in frog and humans. Such gametes are known as anisogametes, or heterogametes, and their fusion is termed anisogamy, or heterogamy.

Special forms of syngamy : These are two special forms of syngamy :

(a) **Neoteny :** Development of gonads and sexual reproduction in the larval stage of an animal is called neoteny. It is found in the axolotl larva of the salamander Ambystoma.

(b) **Polyembryony :** The blastomeres formed by division of the zygote separate in early stages of development, each producing in a complete individual (fasciola liver fluke). Armadillo regularly produces four young ones per zygote. Identical twins in human beings is another example.

(ii) **Conjugation :** Some acellular protist animals (*e.g.* Paramaecium) exhibit sexual reproduction by forming male and female gamete nuclei, which they exchange through temporary cytoplasmic bridge; later, the cytoplasmic bridge disappears and the gamete nucleus of one individual fuses with that of the other to form zygote nuclei. This mode of sexual reproduction is known as conjugation.

(2) **Parthenogenesis (Virgin birth) :** It is a modification of sexual reproduction in which an egg develops into a complete offspring without fertilization. It is monoparental. Parthinogenesis was discovered by Bonnet (1745).

Occurrence : Parthinogenesis is found in many non vertebrates such as rotifers, aphids, bees and crustaceans. It also occur in a few vertebrates.

Types : Parthenogenesis is of two main types –

(i) **Natural parthenogenesis :** It is a regular phenomenon in the life history at some animals. It may be three type.

(a) **Complete (Obligatory) parthenogenesis :** Males are absent, females develop parthenogenetically, *e.g.*, rotifers, Typhlina brahmina (small lizard, 15 cm long), Lacera saxicola-armeniaca (Caucasian Rock Lizard), Cnemidophorus (Whiptail Lizards of America).

(b) **Incomplete (cyclic) parthenogenesis :** Some animals have both sexual and parthenogenetic individuals, which may alternate. In these animals, female can produce unfertilized or fertilized eggs, depending upon environmental conditions. In Daphina, a fresh water crustacean, female lays unfertilized eggs that develop parthenogenetically under favourable conditions, and fertilized eggs during times of environmental stress. In aphids, the insects pests or crops, females produce many parthenogenetic generations from unfertilized eggs alternating with a biparental generation from fertilized eggs.

In honeybee, unfertilized eggs develop into male bees (drones) with haploid cells, and fertilized eggs give rise to females (queen bees and worker bees) with diploid cells. Spermatogenesis in drones is peculiar in lacking reduction division. In turkey, about 40% males are produced by parthenogenesis whereas 60% males and all females develop from fertilized eggs.

(c) **Paedogenetic parthenogenesis :** In certain insects, larvae lay eggs which develop parthenogenetically into a new generation of larvae. Parthenogenesis is larvae is called paedogenesis.

(ii) **Artificial parthenogenesis :** Eggs of certain animals, such as annelids, mollusks, starfish, frog, hen, rabbit, etc., can be induced to develop parthenogenetically by artificial stimuli. Artificial stimuli may be (i) physical, viz., prick of a needle, electric shock, change in temperature or *pH*; or (ii) chemical such as addition of urea, fatty acids, ether, chloroform, to water.

On the basis of chromosome sets parthinogenesis is of two types –

(a) **Arrhenotoky (Haploid parthenogenesis) :** Haploid eggs grow to form haploid males *e.g.*, Arachnids, some insects (honey bees).

(b) **Thelotoky (Diploid parthenogenesis) :** Diploid eggs grow without fertilization in to diploid individuals, generally females. *e.g.*- Gall fly.

Advantages of parthenogenesis

(i) This avoids the wastage of germplasm as sperms and ova. Adult organism is devoted exclusively to feeding and reproduction so is a mode of high reproduction e.g., aphids.

(ii) There is no chance of separation of useful combination of genes by crossing over and are transmitted as such.

(iii) The offsprings are exactly similar to parents.

(iv) Haploid parthenogenesis is the direct proof of chromosomal theory of sex-determination.

Disadvantages of parthenogenesis : It stops the chances of new combinations of genes and thus avoids selection in population. It decreases the chances of adaptability followed by extinction.

(d) **Reproductive unit in sexual reproduction :** The reproductive units in sexual reproduction are specialised cells called gametes. The gametes are generally of two kinds –

(1) Microgametes or Spermatozoa (2) Macrogametes or Ova

Both are well developed for their role in reproduction. The male gametes are mostly minute and motile so that they may swim to the female gametes for fertilization. The female gametes are usually large, non motile and often have a store of food to nourish the developing embryo.

(e) **Maintenance of chromosome number :** The gametes are usually formed by meiotic divisions. Therefore, they are haploid, *i.e.*, have halved or reduced (n) number of chromosomes. In sexual reproduction, the male and female gametes fuse to form a single cell, the zygote formed by the fusion of two haploid gametes in naturally diploid, *i.e.*, has double or normal number (2n) of chromosomes. The zygote gives rise to the offspring by mitotic divisions. Thus, the offspring is also diploid like its parents which formed haploid gametes by meiosis for its creation. Meiosis and fertilization are the two important events in sexual reproduction that keep the number of chromosomes constant from generation to generation.

(f) **Reproduction pattern :** Sexual reproduction shows three patterns depending on whether fertilization and embyronic development occur within or outside the maternal body –

(1) **External fertilization and External development :** This pattern is found in many aquatic animals, such as Obelia, Nereis, Labeo and frog. Parents release sperms and eggs into the surrounding water, where fertilization occurs and zygotes develop into offspring. For this pattern to succeed, male and female must shed their gametes at the same time and place and in large numbers. the parents may or may not make a physical contact for releasing the gametes.

(2) **Internal fertilization and External development :** Sperms are passed from the male into the female with an intromittent organ, such as a penis as in shark and lizard, or otherwise, for example, by cloacal apposition in birds, with modified arm in cuttle fish. Internal fertilization has several advantages. The female reproductive tract provides a confines, protected place where sperm and egg can easily meet without the danger of being eaten up by predators or washed away by water currents. The zygote passing down the female reproductive tract to the exterior can acquires secretions, membranes, or shell for the protection of the developing embryo.

Animals with internal fertilization usually produce fewer zygotes because of protection provided by egg shells or internal development.

(3) **Internal fertilization and Internal development :** Internal development provides additional advantages to the embryo. The mother's body provides exactly the right chemical

conditions and, in mammals, warmth and nourishment also. As the mother carries the embryo wherever she goes, it is not vulnerable to predators who attack externally developing eggs.

(g) **Characteristics of sexual reproduction :** Sexual reproduction has the following important basic features –

(1) It is generally biparental.

(2) It involves formation of male and female gametes.

(3) Mostly there is fusion of male and female gametes (fertilization).

(4) Cell divisions are meiotic during gamete formation and mitotic during development of zygote into an offspring.

(5) The offspring are not genetically identical to the parents. They show variation as they receive characters (chromosomes) from two different parents. Sexual reproduction is, thus, a source of variety in population.

(h) **Significance of sexual reproduction :** Sexual reproduction has a dual significance for the species –

(1) It results in multiplication and perpetuation of the species.

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

Difference between sexual and asexual reproduction

S.No.	Asexual reproduction	Sexual reproduction
1.	It is always uniparental.	It is generally biparental.
2.	It invariably results in increase in the number of individuals.	It may not result in increase in the number of individuals.
3.	Gametes are not formed.	It always involves the formation and fusion of gametes.
4.	There is no fertilization.	Fertilization generally occurs.
5.	It involves only mitotic cell divisions.	It involves meiotic divisions during gamete formation and mitotic divisions during development of zygote into an offspring.
6.	Daughter individuals are genetically identical to the parent.	Daughter individuals genetically differ from the parents.
7.	It occurs in only lower invertebrates and lower chordates.	It occurs nearly in all animals.
8.	It contributes little to evolution.	It contributes to evolution by introducing variation in offspring.
9.	It often causes rapid increase in number.	It causes slower increase in number.

❑ **Blastogenesis and Embryogenesis :** Development of the offspring from reproductive units, such as buds or fragments, in asexual reproduction is called blastogenesis. Development of the embryo from the zygote in sexual reproduction is termed embryogenesis.

❑ **Unisexual or dioecious :** Organism in which the two sexes occur in different individuals, *e.g.*, humans, mammals, birds, lizards.

❑ **Bisexual / Hermaphrodite or monoecious :** Organism in which the two types of sex organs (testes and ovaries) occur in the same individual, *e.g.*, Earthworm, Taenia.

❑ **Deviations in the reproductive strategies :** Although asexual and sexual reproductions are the two major trends of breeding, many deviations are also observed in the reproductive strategies of animals. One such variation in reproductive strategy in hermaphroditism, found in tapeworms and earthworms. Tapeworms are self-fertilising; the sperm produced in the testes of one individual can fertilise the eggs produced by the same individual. The earthworms employ cross, fertilisation; the sperm of one individual fertilises the eggs of the other.

Sexual dimorphism : Differentiation in morphology of the two sexes of the same species is called sexual dimorphism. Example – Ascaris, Oryctolagus and humans etc.

Important Points

- ✍ *The condition of presence of normal number of motile sperms in human semen is termed as isozospermia.*
- ✍ *The condition of presence of completely non-motile sperms in human semen is termed as Necrospermia.*
- ✍ *Smallest eggs are of humming bird.*
- ✍ *In lower animals large amount of eggs are poduced because their chances of survival are very less.*
- ✍ *Order of egg-production. Mammals < Birds < Repitles < Amphibia < Pisces.*
- ✍ *Cat and Rabbit are both induced ovulators.*
- ✍ *The life span of eggs in female reproductive organs is different e.g. in humans it is 48 hours.*
- ✍ *Nucleus of the egg is termed as Germinal vesicle.*
- ✍ *The asexual process replaced by the sexual method is known as apomixis.*
- ✍ *Phallic organs in cockroach are related to male reproductive system.*
- ✍ *No natural death in organisms showing binary fision e.g. Amoeba, so are called immortal.*
- ✍ *The croaking sound made by frog is sex call for female partner.*
- ✍ *Leuvenhock (1677) saw human sperm.*
- ✍ *In frog bidder canal help in sperm passout.*
- ✍ ***Gynandromorph :*** *An animal having male characteristics on one part and female characteristics on the other.*
- ✍ ***Gynaecomastia :*** *Enlarged functional mammary gland in male.*
- ✍ ***Azoospermia :*** *No sperms in semen.*
- ✍ ***Oligospermia :*** *Sperms less than 20 million in per ml semen.*
- ✍ ***R.V. Graf (1672) :*** *Androgenesis discovered follicles in human ovary.*
- ✍ ***Androgenesis*** **:** *Development in which embryo has only paternal chromosomes, male parthenogenesis.*
- ✍ ***Gynogenesis :*** *Development in which embryo has only maternal chromosomes, female parthenogenesis.*
- ✍ ***Gland of Tyson :*** *Modified sebaceous glands present around corona of glans.*
- ✍ *In many birds (exception some birds of prey) only the left ovary and left oviduct are*

function. The right ones are non-functionsl.

- ✍ ***Seminiferous tubules :*** *Structural and functional unit of testes.*
- ✍ ***Hysterectomy :*** *Surigcal removal of uterus.*
- ✍ ***Castration / Chidectomy :*** *Removal of testes. It produce eunuchs. Castration changes aggressiveness of male into docile nature.*
- ✍ ***Corpus luteum :*** *Persists for two weeks in case of non pregnancy and four months when pregnancy has taken place.*
- ✍ ***Prostatitis :*** *Inflammation of prostate gland. Prostate cancer is common in ageing males.*
- ✍ ***Human egg :*** *0.1 mm in diameter.*
- ✍ ***Prostatectomy :*** *Surgical removal of prostate gland.*
- ✍ ***Peculiar spermatozoa :*** *Ascaris has amoeboid spermatozoa devoid of flagellum. Some crustaceans also have atypical sperms.*
- ✍ *Sperms form about 10% of the ejaculated semen.*
- ✍ ***Protandry :*** *Spermatozoa mature earlier than ova in bisexual animals e.g. – Hydra, Earthworm.*
- ✍ ***Andrology :*** *Branch of medicine concerned with diseases peculiar to male sex.*
- ✍ ***Spermatorrhoea :*** *An involuntary discharge of semen, without orgasm.*
- ✍ ***Spermatophore :*** *A capsule containing spermatozoa, as in cuttle fish and salamander.*
- ✍ ***Menarche :*** *Beginning of menstrual cycle and other bodily changes.*
- ✍ ***Oophoritis :*** *Inflammation of an ovary.*
- ✍ ***Vitellogenesis :*** *Process of laying down of yolk in the primary oocyte. It occurs in the prophase of meosis-I.*
- ✍ ***Metagenesis :*** *Alternation of sexually and asexually reproducing forms in the life cycle of an animal e.g. Obelia.*
- ✍ ***Protogyny :*** *Ova mature earlier than sperm in abisexual animal e.g. Herdmania.*
- ✍ ***Spermathecae :*** *Small sacs that form a part of female reproductive system of earthworm and store spermatozoa received from the male for use in future.*
- ✍ ***Oviparous :*** *Animals that lay eggs e.g. – Birds.*
- ✍ ***Viviparous :*** *Animals which give birth to young ones, e.g. most mammals.*
- ✍ ***Ovoviviparous :*** *Animals that produce eggs which hatch within their bodies.*
- ✍ ***Ovipositor :*** *A specialised female organ for laying eggs, specially in insects.*
- ✍ ***Rutting season :*** *It is a brief period of pronounced sexual activity in males.*
- ✍ ***Tubectomy (Salpingectomy) :*** *Surgical removal of oviducts.*
- ✍ ***Von bear :*** *Discovered ovum.*
- ✍ ***Strobilation :*** *Asexual multiplication by transverse fusion and is found in Scyphistoma of Aurelia and also found in Taenia.*
- ✍ *Richard owen gave term parthinogenesis.*
- ✍ *Testes are also called spermaries.*
- ✍ ***Vaginal coelom :*** *Cavity of scrotal sac.*

- *Leydig cells are absent from the testes of frog and are characteristics of mammalian testes.*
- ***To-gene :** Testicular organisation gene located on Y-chromosome and is a male determining factor.*
- ***Adiposogenital syndrome :** Hypogonadism in male and characterised by obesity and child like sexual organs.*
- ***No man - no woman syndrome :** Characterised by male-female pseudohermaphroditism in which external sexual characters are opposite to genetic and gonadal sex.*
- ***Wolffian duct :** Acts as male genital duct, while mullarian duct is vestigeal.*
- ***Mesosalpinx :** Mesentry suspending the fallopian tube.*
- ***Mesometrium :** Mesentry suspending the uterus.*
- ***Uterus :** It is also called womb.*
- *Cervix of uterus is formed of most powerful smooth muscles.*
- ***Vestibule :** Acts as a urinogenital sinus.*
- ***Perineum :** Area between the fourchette and anus.*
- *Bartholin's or Bulvo vestibular glands of female homolegous to Cowper's glands of male.*
- ***Precocious puberty :** Puberty attained before the normal age.*
- ***Hypermastia :** More than normal number of breasts.*
- *Number of breasts in female depends upon the number of young ones born at a time.*
- *Female ascaris has paired ovaries so is called didelphic.*
- *In seasonally breedings animals, testes show testicular cycle.*
- *Spermatogenesis is continous process, while oogenesis is a discontinuous process.*
- *In spermatogenesis, spermatogonium produces four sperms while in oogenesis, one oogonium produces one ovum and 2 or 3 polar bodies.*

Memories

- *The longest phase of gametogenesis is growth-phase.*
- *Acrosome of the sperm is formed by the golgi-body.*
- *Smallest sperm is of Crocodile (.02mm) and largest sperm is of discoglossus (2mm)*
- *Complete spermatogenesis in man takes place in 74 days.*
- *In 1ml of human semen 100 million sperms are present.*
- *Infertility which arises die to less number of sperms is called Oligospermia.*
- *Condition in which sperms are totally absent in semen is also termed as Azospermia.*
- *In oogenesis, yolk is synthesised in the growth phase.*
- *Largest egg is of Ostrich which along with the shell is of 16 cms.*
- *Length of a human sperms in approx 55μ i.e.*

IMPORTANT PRACTICE QUESTION SERIES FOR NEET EXAM – 1

1. In oviparous individuals development of zygote takes place