

ST. LAWRENCE HIGH SCHOOL



A JESUIT CHRISTIAN MINORITY INSTITUTION

STUDY MATERIAL -1

Class: XII

Sub: BIOLOGICAL SCIENCE

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Topic - <u>REPRODUCTION IN ORGANISMS (CHAPTER 1)</u>

INTRODUCTION

Definition of reproduction

The process by which a fully developed organism produces a new individual of its kind, is known as reproduction.

IMPORTANCE OF REPRODUCTION

- Maintaining the existence of Life : Living world maintains its existence by producing new descendants through reproduction.
- > Multiplication : Organisms multiply their own species by reproduction.
- Maintaining the Continuity: Through reproduction living organisms maintain their succession in nature.
- Setting up the Balance in Nature : Production of similar offspring helps to maintain the balance on this earth.
- ➤ Helps the Evolution : The variations appearing through sexual reproduction help in evolution.
- Origin of Mutation : There is a chance for mutation at the time of sexual reproduction by which new species may originate.
- Production of Hybrid Varieties : Hybrid varieties may be produced by interspecific sexual reproduction by which new species may originate.
- Produce genetic diversity : Reproduction introduces variations in the organisms. Useful variations are essential for the adaptations and evolution. Sexual reproduction provides genetic diversity because the sperm and egg that are produced contain different combinations of genes than the parent organisms. Asexual reproduction on the other hand, does not need sperm and eggs since one organism splits into two organisms that have the same combination of genes.
- **Species continuity** : Continuity of species, maintained by the reproduction.
- Organization of population : Reproduction maintains, the population of young, adult and the aged persons.

LIFE SPAN

The period from birth to natural death is the life span of an organism. It may be few minutes to several years. Life span of some microorganisms is few minutes and red wood tree is the longest living plant (3000-4000 yrs.). Life span of May fly is one day only and that of giant tortoise is 200 years.

An organisms life span consists of four stages.

- > **Juvenility** : In the stage organism become capable for reproduction.
- > Maturity : In this stage reproduction begins.
- > Ageing : In this stage progressive deterioration proceeds.
- Death : In this stage, the cessation of all biological function that sustain a particular living organism

DIFFERENCE BETWEEN AGEING AND SENESCENCE

Ageing	Senescence
1. It is a progressive deterioration and general decline in metabolic processes of the body.	 It is the terminal irreversible stage of ageing. It leads to the death.

TYPES OF REPRODUCTION

Reproduction is the fundamental characteristics of living organisms. It involves the transmission of genetic material from one generation to the next ensuring that the species survives over long periods of time.

CLASSFICATION OF DIFFERENT TYPES REPRODUCTION



Types of Reproduction	Definition	Example
1. Asexual Reproduction	The process by which reproduction takes place without formation of gametes and produces offspring simply by cell division or by spore formation is called asexual reproduction.	<i>Mucor, Agaricus, Amoeba, Hydra</i> etc.
2. Vegetative Reproduction	The process by which new individuals are formed directly from the vegetative parts of living organisms without any change in protoplast is called vegetative reproduction.	Potato, Rose, Yeast, bacteria etc.

TYPES OF REPRODUCTION

3. Sexual Reproduction	The process by which reproduction takes place by the union of two different gametes, i.e., male gamete and female gamete is known as sexual reproduction.	Higher groups of plants and animals, e.g., Rice, Wheat, Mango, Cat, Cow, Man etc.
4. Parthenogenesis	The process by which young ones develop from the eggs without fertilization, is known as parthenogenesis.	<i>Spirogyra, Mucor,</i> Bees, Ants etc.

ASEXUAL REPRODUCTION

Production of offspring by a single parent without formation and fusion of gametes is called asexual reproduction. Meiosis does not occur in asexual reproduction. All divisions are mitotic. All the individuals formed through asexual reproduction from a parent are genetically similar to one another as well as their parent. A morphologically and genetically similar individual is called **clone**. Asexual reproduction is common among lower groups or organisms simple plants and simple animals. It is absent in higher Invertebrates and vertebrates.

Characteristics of Asexual Reproduction

- > A single parent is involved in reproduction.
- Gametes are not formed in asexual reproduction.
- Fertilization does not occur.
- > No meiosis, only mitotic cell division takes place.
- > Daughter individuals are genetically identical parents.
- Multiplication occurs in rapid manner.

TYPES OF ASEXUAL REPRODUCTION : Asexual reproduction takes place by 1. Fission 2. Budding 3. Regeneration 4. Fragmentation 5. Gemmule formation 6. Sporulation (spore formation)

1)FISSION : This is type of asexual reproduction in which body of the parent individual divides into two or more equal sized daughters. It can occur by binary fission, multiple fission and plasmotomy.

Binary Fission : It is the division of parent individual into two almost equal halves each of which functions as an independent daughter individual.

Depending upon the plane of division, binary fission is of the following types -

- > Irregular binary fission : Division can occur through any place. e.g., Amoeba.
- Longitudinal binary fission : The place of division passes along the longitudinal axis of the animal. It occurs in Euglena, Vorticella.

Trasverse binary fission : The plane of division runs along the transverse axis of the individual. e.g., Paramoecium, Planaria.



Process of Binary fission

MULTIPLE FISSION

This type of reproduction occurs in *Amoeba*, *Plasmodium* etc., where repeated nucleus and cytoplasmic division produces numerous daughter cells, each of them ultimately gives rise to a new individual. Under unfavorable conditions, *Amoeba* withdraw its pseudopodia and secrets a three-layered wall. i.e.,cyto wall. This phenomenon is referred to as **encystment**. This cyst wall is extremely resistant to the unfavorable environmental condition and even to antibiotics. *Amoeba* can survive inside the cyst for a very long time.

2)BUDDING

In this process the daughter individuals are formed from the parent as small outgrowth or bud which grows gradually and acquires the form of parent.

(i) **Budding in yeast** : A small outgrowth is formed from the cell wall, increases in size, initially remains attached to the parent body. Later on, it gets separated and matures into new organism.

- (ii) Budding in animals : It is of two types :-
 - Exogenous or External budding : A bud develops from the body surface of the parent individual. It grows in size and forms a young individual. It grows in size and forms a young individual. The bud separates from the parent to lead an independent life as in Hydra or remains attached to the parent to form a colony.
 - Endogenous or Internal budding : In fresh water sponges (e.g., Spongilla) and in marine sponges (e.g., Sycon), the parental individual releases a specialized mass of cells enclosed in a common opaque envelope, called the gemmules. Each gemmule consists of small group of totipotent cells called archaeocytes.



3)REGENERATION

This type of reproduction is found in Planaria. Hydra and flatworm. If the body of the animal is fragmented by any means into pieces, each of the gramented parts develop into a new animal through cell division.

Regeneration is divided into two following type :-

- Repairative Regeneration : In this type of regeneration, only damaged tissue can be regenerated.
- Restorative Regeneration : In this regeneration some body parts can be reformed or a complete body develop from a body part.



4)FRAGMENTATION

In this method, the body of the adult organism breaks apart into two or more pieces, each of which then grows and reforms the deficient parts to reconstitute a complete animal. It is found in sponges, coelenterates and echinoderms such as Starfish.

Fragmentaion is also found in algae (*Spirogyra*), fungi (*Rhizopus*), bryophytes (*Riccia*, *Marchantia*), pteridophytes (*Selaginella rupestris* etc.

5)GEMMULE FORMATION

The bud-like organ is called gemmule, which is formed inside the body of some sponge. These gemmules after maturation detach from the mother's body and develop into new individuals. There are small groups of cells i.e., archaeocytes enclosed by a protective coat. Archaeocytes comes out through micropyle during favorable conditions and later forms a new colony.



6)SPORULATION (SPORE FORMATION)

Spore formation is a common form of asexual reproduction, which is widely distributed among plants and in certain protozoans (Sporozoa). Spores are minute, single-celled reproductive units formed by cell division of parent body either exogenously or endogenously. Each spore after release from the parent body germinates to form new individual. Sporulation is common in members of monera, protista, fungi and algae.

Spores are of the following types :

Endospore : Endospore is a dormant, tough and non-reproductive structure produced by certain bacteria. It is a seed like form, but it is not a true spore. It is a stripped down, dormant form to which the bacterium can reduce itself. Endospore formation is usually triggered by a lack of nutrients. Zoospore : Zoospores are unicellular flagellate motile spores are produced endogenously within the sac-like structure called zoosporangium. e.g., Ulothrix (algae), Synchitrium (Fungi).

In case of zoospore, two types of distinct clagella are found in various combinations. Those are :-

(i) **Tinsel flagella** : This flagella have lateral filaments i.e., mastigonemes which is perpendicular to the main axis which allow for more surface area, and disturbance of the medium, giving it the property of a rudder, i.e., the purpose of being used for steering.

(ii) **Whiplash flagella** : They are straight, to power the zoospore through its medium. These is also the 'default' zoospore. which only has the propelling, 'whiplash' flagella.



Spore of Saprolegnia having whiplash type and tinsel type flagella

APLANOSPORE

These are unicellular, non-motile, non-flagellate and endogenously produced spores formed within the sporangium or any other similar spore producing structure. e.g., *Mucor*.

Different types of aplanospores are discussed in the following :-

(i) Sporangiospore : The more primitive fungi (Rhizopus, Mucor) produce spores in the

sporangia, which are sac like sporophores whose entire cytoplasmic contents cleave into several spores i.e., called as sporangiospores. Sporangiospores are either naked and flagellated (as zoospores) or walled and non motile (as aplanospores).

(ii) **Conidia** : These are non motile spores cut off externally either singly or in chains from the tip of conidiophore. It is a type of asexual reproductive spore of fungi (*Penicillium*). It usually produced at the tip or side of the hyphae or an a special spore producing structures i.e., conidiophores.

(iii) **Oidia** : It is also an asexually produced fungal spore, that is presumed no to constitute the main reproductive preoccupation of the fungi at that time. When the hyphae breaks up into a small pieces of component cells then those are developed into the spores.



Fig. 4.8: Various types of asexual spores of fungi : A. Conidia in chain bome on conidiophore in Erysiphe, B. Endoconidium from conidiophore in Cerutostometia sp., C. Conidia on branched conidiophore in Pencilifum, D. Development of oldum, E-G. Chiamydospores, H-J. Development of Zoospores in Phytophthorus, K. Portion of plant body of Rhizopus showing nitizoids, sporangiophores and sporangia, and L. Pontion of sporangiophore of Rhizopus with single sporangium.

IMPORTANCE OR ADVANTAGES OF ASEXUAL REPRODUCTION

- > Asexual reproduction is capable of producing new individual in a short time.
- > There is no opportunity of variation among the offsprings.
- It is a simple and easy method of reproduction.
- Only one individual is required for this process.
- Regarding characters, offsprings resemble the parents.
- It is a safe reproductive process in adverse situations.
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DISADVANTAGES OF ASEXUAL REPRODUCTION

- It never produces new varieties.
- There is no possibility of variation among the offsprings. As a result, all the fixed characters are transmitted to the organism generation after generation.

VEGETATIVE REPRODUCTION OR PROPAGATION IN PLANTS INTRODUCTION

Vegetative propagation or reproduction is the process of multiplication in which a portion or fragment of plant body functions as a propagule and develops into a new individual. Vegetative propagation is form of asexual reproduction in plants.

CHARACTERISTICS OF VEGETATIVE REPRODUCTION

- Apart from sexual and asexual reproduction, vegetative reproduction is comparatively simple and prime process.
- > This reproduction takes place simply by the cell division or by separation from mother's body.
- > Mitotic cell division takes place and only one individual is required.
- > Offspring bears similar parental qualities.

CLASSIFICATION OF VEGETATIVE PROPAGATION IN PLANTS



Natural vegetative propagation

In this method, vegetative propagules detach from the mother plant and develop into new plants under suitable conditions. It takes place by the following methods :-

(i) Propagation by the adventitious bud

The adventitious buds are the subnormal buds found at the points along the stem. They arise from the dormant buds in the leaf axils of the young stem and persist for an indefinite number of years within the cortical-cambial zone.

Different types of adventitious buds are :-

- Root Bud : In case of *Ipomoea*, the adventitious buds of the roots become developed and formed now individual plant.
- Stem bud : New individual plant grows from the developing nud of the Dahlia, Rose's stem.
- Leaf bud : In case of Bryophyllum, Begonia, adventitious bud groups from the leaf and then matured and detached from the mother body, gives rise new individual plant. In case of Bryophyllum buds on marginal notches of intact leaves from plantlets while attached to the plants.

PROPAGATION BY STEMS:

UNDERGROUND MODIFIED STEMS

Underground stems are modified plant structure that derive from stem tissue but exist under the soil surface.

(i) **Tuber** : These are fleshy, swollen, rounded or oblong distal portions of underground axillary or adventitious branches. The tips of these branches become enlarged in the form of tubers, due to accumulation of surplus food material manufactured by the aerial shoots. Each tuber possess a number of depressions called eyes. Each eye represents node. It has a scale leaf in the form of a ridge. Each eye contains 1-3 dormant buds. The stem-tuber lacks adventitious roots. E.g., (Potato

(ii) Rhizome : These are fleshy, horizontally growing, perennial, underground stem, which continue to grow for an indefinite period producing new leaves or shoots during favorable period. The aerial leaves or shoots die during unfavorable condition and are replaced by the new ones on arrival of next favorable period. A rhizome is differentiated into nodes and internodes. The nodes bear scale leaves that protect axillary buds. e.g., Ginger (*Zingiber officinale*).
(iii) Bulb : This is another underground modified shoot in which the axis, i.e., the stem is extremely short length to a convex disc with compressed internodes, and consisting of a terminal bud and numerous fleshy scale leaves with axillary buds. The base of discoid stem bears fibrous adventitious roots. The terminal bud develops into a leafless hollow floral axis called scape.

(iv) **Corm** : This a stout, solid, fleshy underground root-stock with a large apical bud. It bears a number of circular nodes with scales, which represent thin sheathing bases of fallen dead leaves. The nodes bear axillary buds. A large number of adventitious roots are also borne at the base of the corm. E.g., *Amorphophallus*



Modes of Vegetative propagation

SUBAERIAL MODIFIED STEM

Some weak herbaceous plants produce modified branches which grow and finally give rise to small daughter plants. In this way a colony of plants is produced.

(i) **Runners** : These are subaerial, weak, slender, lateral branches, that grow horizontally along the soil surface. They grow from basal axillary buds of the short, erect shorts. A number of runners arise from a erect shoot and spread in different directions and ultimately bear new crowns and tuft of adventitious tools at nodes. E.g., *Marsilea*, *Oxalis* etc.

(ii) **Suckers** : Sucker is an underground runner, which arises from the underground base of the aerial shoot, grows horizontally in the soil and ultimately comes out to form new aerial green shoot. Each sucker has one or more nodes with scale leaves and axilary buds.

(iii) **Stolons** : These are elongated arched or horizontal runners with long internodes, which develop adventitious roots on coming in contact with the soil at the nodes. A stolon bears scale leaves and axillary buds at the nodes. The axillary buds may either form a secondary stolon or may grow up as an erect short aerial stem.

(iv) **Offsets** : These are just like runners but the internodes are shorter and stouter than the runners. An offset arises from an axillary bud at the base of the cluster of leaves. It runs horizontally for a short distance and terminates in a bud that develops adventitious roots and a cluster of leaves. E.g., *Eichhornia, Pistia* etc.



SEXUAL REPRODUCITON

Definition : Reproduction which takes place by the union of two different gametes, i.e., male gamete and female gamete is known as sexual reproduction.

CHARACTERISTICS OF SEXUAL REPRODUCTION

- > It is a improved process. This reproduction process takes place through the union of gametes.
- > During this reproduction two individuals are required, those are unite with each other.
- > Meiotic cell division takes place at any stage of this process.
- Variation always appears in the offsprings.
- > Due to presence of variation which have a positive role in evolution.
- > Presence of distinct alternation of generation is the life cycle.

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TYPES OF SEXUAL REPRODUCTION

Sexual reproduction is of two types . (i) Conjugation (ii) Syngamy

CONJUGATION

The process of fusion between the two isogametes or fusion between two isogametangium of the same species is known as conjugation.

Generally, conjugation process is found in lower groups of plants and animals. Conjugation takes place between the cells of two sexually different plants and animals. In plants, the cells of two filaments which are in contact form protrusions which form protrusions which lie opposite one another.

SYNGAMY

Definition : The process of fusion between two different male and female gametes where one is smaller and flagellated and the other is larger and non-flagellated is called syngamy.

According to the structure of fusing gametes syngamy is of four types :

(i) **Isogamy** : In syngamous sexual reproduction, where two morophologically identical gametes or equal size and form. i.e., isogametes fuse in pair forming a zygote is called isogamy. E.g., *Mucor*, *Monocystis*.

(ii) **Anisogamy** : In this type, the morphologically non-identical gametes, ie., gametes of unequal size fuse to form zygote known as anisogamy. Of the two non-identical gametes, the smaller male gametes are called microgametes and the larger female gametes are called macrogametes. These two gametes afte their union produce zygote outside the body, e.g., *Chalmydomonas*.

(iii) **Oogamy** : Oogamy is a complex type of sexual reproduction. In this type, fusion takes place between two heterogametes, one is smaller, active and flagellate known as the male gamete (antherozoids, spermatozoids, sperm) and the other one is larger, passive and non-flagellate known as the female gamete (oospore, ovum, egg). As a result of such union, i.e., fertilization oospore (zygote) is formed. The zygote gives rise to a new plant, e.g., human and other mammals.

(iv) **Hologamy** : Hologamy means, when two organisms act as gametes and fuse with each other, e.g., Yeast (*Saccharomyces cerevesiae*).



DIFFERENT EVENTS OF SEXUAL REPRODUCTION



<u>Pre-fertilization Events</u>: These events are prior to the fusion of male and female gametes. This stage is divided into gametogenesis and gamete transfer.

(i) **Gametogenesis** : It is characterized as the process of the formation of two different types of gametes i.e., male and female gametes. These are haploid cells. In some algae, gametes are similar in appearance, so they cannot be categorized into male and female gametes. Such gametes are called homo gametes or isogametes. In other case, when two gametes are structurally and functionally different, then these gametes are called heterogametes.

(ii) **Gamete transfer** : After the formation of male and female gametes, they are brought together for fertilization. Male gamete is motile whereas female gamete is non-motile. Due to fusion of gametes, zygote is formed which gives rise to new individual.

FERTILIZATION

Definition : The union of male and female gametes is known as fertilization.

Gamete is the union of sexual reproduction. The fusion product of two gametes, in general is called zygote. Fertilization involves physical entry of the sperm and also physiological processes in both egg and sperm. During fertilization, the female gamete remains confined within the oogonium. The anterozoids when matured are liberated from the anteridium, which swim around in the water and enter the oogonium. But only one sperm can unite with the ovum.

Types of Fertilization : Fertilization is of different types. They are as follows :

(i) **Internal Fertilization** : It is the most common method of fertilization where union of gametes takes place inside the body of the female. The male gamete is transferred to the female body from the male by sex organs or other means, e.g., Birds and Mammals.

(ii) **External Fertilization** : In this type of fertilization, the egg and sperm are simultaneously shed into the water and the sperm swim through the water to fertilize the egg in a process known as broadcast fertilization. It is common in many aquatic animals e.g., *Hydra*, coral and in most fishes.

(iii) **Self Fertilization** : When fertilization union of male and female gametes takes place within the same individual, i.e., known as self fertilization, e.g., Bisexual flowers Tape worm, etc.

(iv) **Cross Fertilization** : When fertilization takes place between two different individuals, i.e., union of male and female gametes of different individuals of the same species, is known as cross fertilization., e.g., unisexual plants like palm, coconut, papaya etc, and unisexual animals like toad, reptiles, fish, mammals etc.

POST FERTILIZATION CHANGES

During sexual reproduction, changes that occur after formation of zygote (2n) is recognized as post-fertilization events.

(i) **Zygote formation** : In case of all sexually reproducing organisms, diploid zygote is formed in the external medium, whereas in internal fertilization, zygote is formed inside the body of the organism.

(ii) **Embryogenesis** : In this process the development of embryo takes place from the zygote which undergoes cell division that increases the number of cells in the developing embryo. Cell differentiation helps groups of cells to undergo several modification to form specialized tissues and organs to form an organism.

DEVELOPMENT OF EMBRYO INVERTEBRATE ANIMALS

(i) **Oviparous** : The process of development of the embryo in the fertilization or unfertilized egg outside the body of some animals is called Oviparous animals, e.g., Fish, Amphibia, Reptiles, Birds etc.

(ii) **Ovoviviparous** : The process of which the embryo is developed inside the animal body but it does not depend for nutrition on the mother's body is called ovoviviparous. E.g. shark

(iii) **Viviparous** : The process where the embryo is developed and fully grown inside the mother's body by taking shelter and nutrition both, is called viviparous animal, e.g., Guineapig, Cow, Man etc.

QUESTIONS RELEVANT TO THE TOPIC:

Short answer type:	
1)Define:	
i) Gemmule	v) offset
ii)Aplanospores	iv) Syngamy
iii)Budding	vi)stolon

Long anser type:

i) Explain the various types of modes of reproduction by sub aerial stems with suitable examples.

ii) Briefly describe the events of sexual reproduction

- iii) Explain different types of syngamy.
- iv) Briefly describe the various types of spores for asexual reproduction.