CLASS XII
BIOLOGY
CH 1 REPRODUTION IN ORGANISM

Reproduction is a biological process of formation of new offsprings from the pre-existing organism.Reproduction becomes a vital process without which species cannot survive for long It ensures continuity of species generation after generations as older individuals undergo senescence and ultimately they die.

Life span - • The period from birth to the natural death of an organism represents its life span. Life span of organisms varies from few days (Butterfly-1to 2 weeks) to thousands of years (Banyan tree).

Types of Reproduction:

Based on whether there is one or two organisms taking part in the process of reproduction

- **ASEXUAL REPRODUCTON**
- **SEXUAL REPRODUCTION**

When the offspring is produced by single parents with or without the involvement of gamete formation, the reproduction is called asexual reproduction.

When two parents (opposite sex) participates in reproduction process and also involves the fusion of male and female gametes, it is called sexual reproduction.

Asexual Reproduction

1. Usually followed by organisms with relatively simpler organizations.

2. Off springs produced by single parent.

3. With/without involvement of gamete formation.

4. Off springs produced are genetically and morphologically similar to each other and to the parent, i.e. they are clones.

• In Protista and Monera, the parent cells divides into two to give rise to new individuals. Thus, in these organisms cell division is the mode of reproduction itself.

• Binary fission- in this method of asexual reproduction, a cell divides into two halves and rapidly grows into an adult. Ex- amoeba, paramecium.

• Budding- small buds are produced that remain attached initially with parents and get separated on maturation. Ex. Yeast.

• Fungi and simple plants like algae reproduce through special reproductive structures like zoospores (motile structure), conidia (penicillium), buds (hydra) and gemmules (sponges).

• In plants, vegetative reproduction occurs by vegetative propagules like runner, rhizome, sucker, tuber, offset and bulb.

WATER HYACINTH (Terror of Bengal)

One of the most invasive weeds grows wherever there is standing water drains oxygen from water- leads to death of fishes. Introduced in India because of its pretty flowers & shape of leaves vegetative propagation occurs at a phenomenal rate.

Asexual reproduction is the most common method of reproduction in organisms having simpler body like in algae and fungi but during unfavorable condition they shift to sexual reproduction.

SEXUAL REPRODUCTION:

Involves formation of male and female gamete by two individuals of the opposite sex offspring produced by fusion of male and female gametes not identical to each other or to the parents. All sexually reproducing organisms share a similar pattern of reproduction.

• In sexual reproduction, fusion of male and female gametes results in offspring that are not identical to parents.

DIFFERENT PHASES IN SEXUAL REPRODUCTION:

a. Juvenile phase - The period between birth and sexual maturity is called juvenile phase. In plants it is known as vegetative phase.The end of juvenile/vegetative phase marks the beginning of the reproductive phase.

b. Reproductive phase-

• Some plants show flowering in particular season and some other flowers in all seasons.

Some other plants like bamboo species flowers once in life time (after 50-100 years), Strobilanthus kunthiana (neelakuranji),flowers once in 12 years.

• The female placental animals exhibit cyclic change in activities ovaries and accessory glands as well as hormone during the reproductive phase.

Menstrual cycle

• It occurs in monkeys, apes and human beings.

• Cycle consists of 3 phases-menstrual, proliferative and secretory phase.

• Blood flows in the last few days of the cycle. The broken endometrium is passed out during menstruation.

• Female does not permit copulation during menstrual phase of the cycle.

Oestrous cycle

• It occurs in non primates like cow, sheep, rat, deer, dog, tiger etc.

• It consists of a short period of oestrous or heat. it is 12-24 hours in cow followed byanoestrous or passive period.

• Blood does not flow in this cycle. The broken endometrium is reabsorbed.

• Female permits copulation only during oestrous period.

• Both in plants and animals, hormones are responsible for the transition between different phases of life cycle. Interaction between hormones and environmental factors regulate the reproductive processes.

c. Senescent phase - It is the end of reproductive phase.

Old age ultimately leads to death

Events in Sexual Reproduction : Pre-fertilisation, Fertilisation, Post-fertilisation

Pre-fertilisation- all the events prior to fusion of gametes are included in it. It includes gametogenesis and gamete transfer.

a. Gametogenesis is the process of formation of male and female gametes. Gametes are haploid cells which may be similar or dissimilar in structure. In algae, both gametes are similar in structure called homogametes (isogametes). In higher organism that reproduces sexually, two morphologically distinct gametes are formed called heterogametes, male gametes are called antherozoid or sperm and female gametes are called ovum or egg. Isogametes. heterogametes

In fungi and plants, homothallic and monoecious terms are used to denote the bisexual condition and heterothallic and dioecious are used for unisexual condition. In flowering plants, the unisexual male flower is staminate, i.e., bearing stamens, while the female is pistillate or bearing pistils.

• In animals, species which possess both male and female reproductive organs in sameindividual are called bisexual or hermaphrodites (earthworm, sponges, tapeworm etc.) and both having either male or female reproductive organs are called unisexual (cockroach, human).

• Gametes are always haploid(having half set of chromosome), although organisms may be haploid and diploid. Diploid organisms form gametes by meiotic division. The organisms belonging to algae, fungi, and bryophytes have haploid plant body and pteridophytes, gymnosperms, angiosperms and most of animals are diploid (having double set of chromosome)

• In diploid organisms, gamete mother cell (meiocyte) undergoes meiosis in which one set of chromosome is present in gametes.

b. Gamete Transfer – in majority of organisms, male gametes are motile and females gametes are non-motile, except in fungi and algae in which both gametes are motile.

• In simple plants like algae, fungi, bryophytes and pteridophytes water is the medium through which male and female gametes moves. The number of male gametes are much more than number of female gametes as most of male gametes fail to reach the female gametes.

• In higher plants pollen grains are carrier of male gametes and ovule has eggs. Pollen grains must be transferred from anther to stigma to facilitate fertilisation. The transfer of pollen grains from anther to stigma is called pollination. Pollination may be self (anther to stigma of same flower) or cross (anther to stigma of different flower).

• Pollen grains germinate on stigma to produce pollen tube that delivers the male gametes near the ovule.

c. Fertilisation – The fusion of male and female gamete is called fertilization or syngamy. It results in the formation of diploid zygote.

• The process of development of new organisms without fertilisation of female gametes is called parthenogenesis. For example honey bee, rotifers, and lizards

EXTERNAL FERTILIZATION INTERNAL FERTILIZATION

Syngamy occurs outside the body of the organism Large numbers of gametes are released in the surrounding medium. Ex. Bony fishes and Amphibians

Syngamy occurs inside the body of the organism

Numbers of ova produced are less, but large numbers of male gametes are released and they travel towards the ovum. Ex. Birds and Mammals.

d. Post Fertilisation Events- events in the sexual reproduction after formation of zygote.

Zygote is the vital link that ensures continuity of species between organisms of one generation and the next. Every sexually reproducing organism, including human beings begin life as a single cell–the zygote.

• In the organisms, having external fertilisation, zygote is formed in external medium (water) and those having internal fertilisation zygote is formed inside the body of female.

• In algae and fungi, zygote develops a thick wall resistant to desiccation and damage. This germinates after a period of rest.

• In the organisms having haplontic life cycle, zygote divides to form haploid spores that germinate to form haploid individual.

Embryogenesis – the process of development of embryo from the zygote. During this, zygote undergoes mitotic division and cell differentiation. Cell division increase the number and cell differentiation help in formation of new group of cells and organs.

Oviparous Viviparous

Development of zygote takes place outside the body of organisms and lay fertilized of unfertilized eggs. Ex - Reptiles and birds.

Development of zygote takes place inside the body of organisms and produces young ones.Ex- Human, dog, horse etc.

• In flowering plants, zygote is formed inside the ovule. After fertilisation, sepals, petals and stamens of flower fall off. The zygote develops into embryo and ovules into seeds. The ovary develops into fruits which develop a thick wall called pericarp, protective in function.

• After dispersal, seeds germinate under favorable condition to produce new plants.

A few kinds of fruit showing seeds (S) and protective pericarp (P)

CHAPTER-02
SEXUAL REPRODUCTION IN FLOWERING PLANTS

Reproduction ensures continuity of species generation after generations as the older individuals undergo senescence and die. Flowering plants shows sexual mode of reproduction and bears complex reproductive units as male and female reproductive units along with accessary structures.

Flower is a modified stem which functions as a reproductive organ and produces ova and/or pollen. A typical angiospermic flower consists of four whorls of floral appendages attached on the receptacle: calyx, corolla, androecium (male reproductive organ consisting of stamens) and gynoecium (composed of ovary, style and stigma) .

Pre-fertilisation: Structures and Events

• Several structural and hormonal changes lead to formation and development of the floral primordium. Inflorescence is formed that bears floral buds and then flower.

• In flowers, male (androecium) and female (gynoecium) differentiate and develops in which male and female gametes are produced.

Stamen, Microsporangium and Pollen Grain :

• Stamen consists of long and slender stalk called filament and generally bilobed anthers.

Each lobe contains two theca (dithecious).

• The anther is four-sided structure consisting of four microsporangia, two in each lobes.

/ 11

• Microsporangia develop further and become pollen sacs which contain pollen grains.

• Microsporangium is generally surrounded by four layered walls- the epidermis, endothecium, middle layer and tapetum. Innermost layer tapetum nourishes the developing pollen grains.

• Sporogenous tissues- It is compactly arranged homogenous cells which are present at centre of each microsporangium when the anther is young..

Microsporogenesis- The process of the formation and differentiation of microspores (pollen grains) from microspore mother cells (MMC) by reductional division is called microsporogenesis.

• The cells of sporogenous tissues undergo meiotic division to form microspore tetrad. As the anther mature and dehydrate, the microspore dissociate and develops into pollen grains.

Pollen grain represents the male gametophytes. Pollen grains are made of 2 layered Wall,

1. Exine :-

Made of sporopollenin- most resistant organic matter known.It can withstand high temperatures and strong acids and alkali. No enzyme can degrade sporopollenin

2. Intine :

-Thin and continuous layer

- Made of cellulose and pectin

3. Germ pores

- apertures on exine where sporopollenin is absent

- forms pollen tube.

4. A plasma membrane surrounds cytoplasm of pollen grain.

MATURE POLLEN

— A mature pollen consist of 2 cells with nucleus (Vegetative and Generative)

VEGETATIVE CELL

Bigger

Abundant food reserve

Large irregular nucleus

Responsible for the development of pollen grain

GENERATIVE CELL

- Small
- Involves in syngamy (fuse with an egg)
- Dense cytoplasm and nucleus
- Pollen grains of many species e.g Parthenium cause severe allergies and bronchial diseases in some people and leads to chronic respiratory disorders– asthma, bronchitis, etc.

• Pollen grains are rich in nutrients and are used as pollen tablets as food supplements.

• Viability of pollen grain varies with species to species and should land on stigma before this period to germinate. Pollen grains of large number of species are stored in liquid nitrogen at temperature – 1960, called pollen bank.

The Pistil, Megasporangium (Ovule) and Embryo sac

• Gynoecium may consists of single pistil (monocarpellary) or more than one pistil (polycarpellary) which may be fused (syncarpous) or free (apocarpous). e.g Multicarpellary and syncarpous pistil- Papaver Multicarpellary and apocarpous pistil- Michelia

• Each pistil has three parts the stigma, style and ovary. Inside the ovary is ovarian cavity (locule). The placenta is located inside the ovarian cavity. Megasporangia (ovules) arise from placenta.

Megasporangium (ovule)

Ovule is a small structure attached to placenta.

Funicle – stalk by which ovule is attached to placenta

Hilum- junction between ovule and funicle

Integuments- protective envelops

Micropyle- small opening at the tip of ovule into where pollen tube enters

Pollination – transfer of pollen grains from anther to stigma.

a) Autogamy- transfer of pollen grain from anther to stigma of same flower.

i. Cleistogamous – flower which do not open. cleistogamous flowers are autogamous as there is no chance of cross-pollen landing on the stigma. Cleistogamous flowers produce assured seed-set even in the absence of pollinators. e.g Viola (common pansy), Oxalis, and Commelina.

ii. Chasmogamous- exposed anther and stigma.

b) Geitonogamy – transfer of pollen grains from anther to stigma of different flower of same

plant. Geitonogamy is functionally cross-pollination involving a pollinating agent, genetically

it is similar to autogamy since the pollen grains come from the same plant

c) Xenogamy- transfer of pollen grain from anther to stigma of different plant's flower of same species.

Agents of pollination includes abiotic (water, wind) and biotic (insects, butterfly, honey bee etc. large number of pollen grains are produced by plants using abiotic mode of pollination as most of pollen grains are wasted during transfer.

Adaptations in flowers for Pollination

I. Wind Pollination

pollen grains :– light, non- sticky, winged

anther :- well exposed

stigma :- large and feathery

flower :- one ovule, arranged as inflorescence

Ex : corn cob, cotton, date palm

II. Water Pollination

- Bryophytes, Pteridophytes, Algae

pollen grains : protected by mucilaginous covering

Ex : Fresh water plants- Vallisneria, Hydrilla

Sea grass- Zostera

Main features of wind and water pollinated plants

- produce pollen grains in large no.

- do not produce nectar

III. Insect Pollination

- Flowers : large, colourful, fragrant, rich in nectar

- Pollen grains : sticky

- Stigma : sticky

Certain rewards to pollinators:

nectar and (edible) pollen grains as foods

provide safe place for laying eggs

Ex : Amorphophallus, Yucca

Outbreeding Devices- the various mechanisms take discourage self-pollination and encourage cross pollination as continued self-pollination leads to inbreeding depression. It includes

• Pollen release and stigma receptivity not synchronized.

• Anther and stigma are placed at different position.

• Inhibiting pollen germination in pistil.

• Production of unisexual flowers.

Pollen pistil interaction – the pistil has ability to recognize the compatible pollen to initiate post pollination events that leads to fertilisation. Pollen grain produce pollen tube through germ pores to facilitate transfer of male gametes to embryo sac.

Artificial Hybridization

Crossing diff varieties of species- hybrid individual- with desirable characters of the

parent plants desired pollen grains for pollination- stigma protected from contamination

Emasculation : removal of anther

Bagging : flower covered- bag made up of butter-prevent contamination of stigma from unwanted pollen

Bagged flower- attains receptivity- mature pollen grains- dusted on the stigma – rebagged- fruits allowed to develop

Double Fertilisation- after entering the one of the synergids, each pollen grain releases two male gametes. One male gametes fuse with egg (Syngamy) and other male gametes fuse with two polar nuclei (triple fusion) to produce triploid primary endosperm nucleus (PEN).

Since two types of fusion takes place in an embryo sac the phenomenon is called double fertilisation. The PEN develops into the endosperm and zygote develops into embryo.

Post fertilisation events include endosperm and embryo development, maturation of ovules into seeds and ovary into fruits.

Endosperm- the primary endosperm cell divides many time to forms triploid endosperm tissue having reserve food materials.

Two types of endosperm development :

(i) Free nuclear type (common method)

(ii) Cellular type

(a) Non-albuminous- endosperm completely utilized- before maturation of seeds. e.g pea, groundnut

(b) Albuminous- a portion of endosperm remain in mature seeds. e.g wheat, maize, castor

Embryo- Embryo develops at the micropylar end of the embryo sac where the zygote is located.

Embryogeny – early stages of embryo development .The zygote gives rise to the proembryo and subsequently to the globular, heart-shaped and mature embryo.

Embryo consists of:

embryonal axis

- cotyledons
- plumule
- radicle

Monocotyledonous Seed

- Scutellem = Cotyledon
- Coleorrhiza: undifferentiated sheath covering radical & root cap
- Coleoptile: sheath covering plumule

Seed

- Fertilized and mature ovule develops into seed.

Seed consists of:

- cotyledon(s)
- embryonal axis
- Seed coat- double layered- formed by integuments

Testa (outer coat)

Tegmen (inner coat)

- Micropyle:- small opening on seed coat, it facilitates entry of H_2O & O_2 into seeds (for germination)

Hilum:- scar on seed coat

- Seed - Albuminous / Non-Albuminous
- Perisperm : remnants of nucellus that is persistent. Ex: Black pepper
- Dormancy: state of inactivity

• The wall of ovary develops into wall of fruit called pericarp. In true fruits only ovary contributes in fruit formation by in false fruit thalamus also contributes in fruit formation.

Apomixis

- Form of asexual reproduction- mimics sexual reproduction- seed formed without fertilisation

- Formation of apomictic seeds :

• diploid cell (formed without meiosis)- develop into embryo without fertilization

• cells of nucellus (2n) surrounding embryo sac- protrude into embryo sac- develop into embryos. Ex. Citrus and Mango.

Polyembryony

- Occurrence of more than one embryo in a seed

- Often associated with apomixes. Ex: Citrus, groundnut

(Note- Please draw all the diagrams from NCERT book)