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Reproduction in Organisms

Chapter-1

Class – XII, Subject- Biology

NOTES

Reproduction:

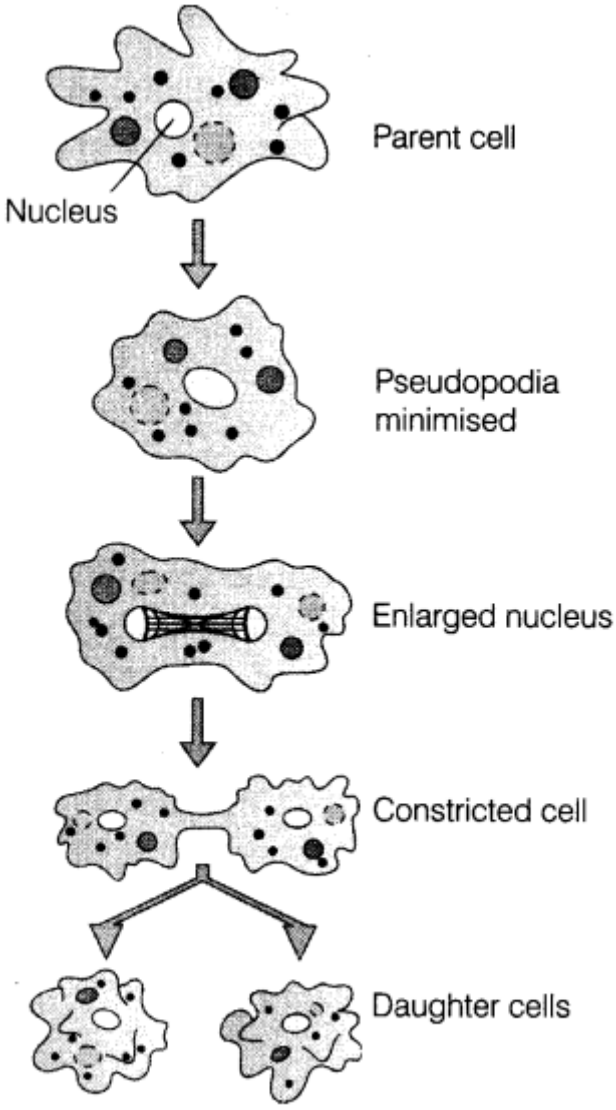
1. The period between birth and natural death of an organism is called its lifespan. It can vary from less than a day to more than 400 yrs.
Whatever be the lifespan, death of every individual organism is a certainty,
i. e. no individual is immortal, except single-celled organisms.
Lifespan of some organisms are given in the following table:

Living organism	Lifespan
Mayfly	1 day
Butterfly	1-2 weeks
Wheat plant	6 months
Crow	15 yrs
Dog	25 yrs
Banana tree	25 yrs
Human	100 yrs
Parrot	140 yrs
Banyan tree	200 yrs

2. Reproduction is a biological process of continuity of a race in which the grown up individuals give rise to off springs similar to them.
It performs the following functions:
(i) Enables continuity of the species.
(ii) Maintains life on the earth.
(iii) Creates variations among population.
The mechanism to produce offsprings shows large variations, depending on organisms habitat, its internal physiology and several other factors.
Based on the participation of one or two organisms, reproduction can be of following two types:
(i) Asexual reproduction
(ii) Sexual reproduction

3. Asexual reproduction A single parent is capable of producing offsprings. Thus, the offsprings are genetically and morphologically identical to one another and to their parent. These are often referred to as clone. The unit of reproduction is commonly formed from the

somatic cells of the parent. Meiosis does not occur in asexual reproduction.
Asexual reproduction is common among single-celled organisms and in plants and animals with simple organisations. Cell division in itself is a mode of reproduction in protists, e.g. bacteria and monerans, e.g. Amoeba (the parent cell divide into two to give rise to new individuals).
Types of asexual reproduction are as given below:



Binary fission in *Amoeba*

I. Fission can be further classified as:

(i) Binary fission The body of an individual divides into two equal halves.
It can be following types:
(a) **Simple binary fission** When division occurs in any plane but it is always right angle to the elongated dividing nucleus, e.g. Amoeba.
(b) **Longitudinal binary** fission When division occurs along the longitudinal axis, e.g. Euglena, Vorticella.
(c) **Oblique binary fission** When division occurs at an angle to the transverse axis, e.g. Ceratium, Gonyaulax.
(d) **Transverse binary fission** When division occurs along the transverse axis of the

individual, e.g. Paramecium, diatoms, bacteria, Planaria.

(ii) Multiple fission The division of the parent body into many daughter organisms, e.g. Amoeba,
Plasmodium, Monocystis (all Protozoa).

Budding in yeast

II. Budding, (torulation) an outgrowth or bud develops, grows, constricts at the base and separates from the parent body, e.g. yeast and Hydra. The complex budded condition is called torala stage.

III. Sporulation occurs by tiny, single-celled, thin-walled spores that are extremely resistant to environmental extremes. The spores form new individuals. It commonly occurs in Monera, Protista, Fungi and Algae.

Spores formed can be of following main types:

(*i*) Pseudopodio spore (with fine pseudopodia)	– *Amoeba*
(*ii*) Zoospores (motile with flagellated)	– *Chlamydomonas* and *Ulothrix*
(*iii*) Conidia (non-motile)	– *Penicillium*
(*iv*) Sporangiospores (non-motile)	– *Rhizopus*
(*v*) Gemmules (internal buds)	– Sponges

IV. Fragmentation occurs by breaking of the parent body into two or more parts, each of which grows to form an independent individual, e.g. algae like Spirogyra and bryophytes such as Marchantia, Riccia.

V. Regeneration is a type of asexual reproduction in which the missing part of the organism is repaired by the proliferation of cells, e.g. Hydra, planaria and sponges.

VI. Vegetative propagation is the formation of a new plants from vegetative parts like root, stem, leaf, etc., naturally, e.g. water hyacinth (scourage of the water bodies or Terror of Bengal) propagates very quickly by vegetative mode and drains out dissolved 02 from water bodies. Some artificial methods of vegetative propagation are also developed by the farmers like cutting, layering, grafting, etc.

Some examples of natural method of vegetative propagation are:

Vegetative part	Example
Roots	*Dahlia*, *Asparagus*, *Dalbergia*, guava and tapioca
Stems	
• Tubers	Potato and artichoke
• Bulbs	Garlic and onion
• Rhizome	Ginger, turmeric, banana and *Dryopteris*
• Corms	*Colocasia*, *Crocus* and *Amorphophallus*
• Suckers	Mint and *Chrysanthemum*
• Runners	*Oxalis* and *Centella*
• Stolons	Jasmine
• Offsets	*Pistia* and *Eichhornia*
Leaves	*Bryophyllum*, *Begonia*, *Kalanchoe* and walking fern
Bulbils	*Agave*, lily and *Dioscorea*
Turions (fleshy buds in aquatic plants)	*Potamogeton* and *Utricularia*

The units of vegetative propagation such as runner, rhizome, sucker, tuber, offset, bulb all have capability to give rise to new offsprings. These structures are known as vegetative propagules.

Necessity Of Reproduction

Reproduction is vital in the process of continuity of species, as a result, sustains a balance in the ecosystem amongst different biotic components precisely. Without reproduction, the life that is thriving now would cease. Reproduction also facilitates evolution due to variations arising from the process of reproduction through the intermingling of species (as seen in sexual reproduction).

Types of Reproduction

Asexual Reproduction

In this mode of reproduction, a new offspring is produced by the involvement or participation of single parents only. The produced offsprings are not only identical but are also the exact copies of their parent because in this process a single parent divides itself to reproduce its offspring.

The different types of asexual reproduction are as follows:

- Budding
- Fragmentation
- Binary fission
- Vegetative propagation

Examples of asexually reproducing organisms:

Asexual reproduction is common among:

1. Single-celled organisms, such as Amoeba, Bacteria, Hydras, yeast cells, etc. In which, Amoeba and Bacteria reproduce by binary fission, Hydras, yeast cells reproduce by budding.
2. Few plants species including, Ginger, potatoes, sugarcane, Agave, Bryophyllum, etc. reproduce through vegetative propagation.
3. Few animal species including, starfish, black worms, etc. reproduce using fragmentation.

Advantages Of Sexual Reproduction:

- Is carried out by a single individual, hence does not require to find a mate
- The process is faster compared to sexual reproduction
- less energy is invested comparatively
- The whole process is less complicated as it involves only a single individual
- can take place in varied environments

Sexual Reproduction

In this mode of reproduction, a new offspring is produced by the participation of two parents of the opposite sex. This type of reproduction is seen in all multicellular organisms including birds, reptiles, dog, cat, cattle's, elephants, etc. The complete process of sexual reproduction consists of a set of events, including:

- Pre-fertilization
- Fertilization
- Post-fertilization

Advantages of Sexual Reproduction:

- Involvement of two parents results in the intermingling of genes resulting in the production of a new offspring
- Genetically identical offsprings are produced
- Variations in species increase the chances of survival hence in the evolutionary advancements
- **1) Juvenile phase –** It is the period of growth after birth in an individual organism, and before it meets reproductive maturity.
- **(2)Reproductive phase –** It is the time when a human organism sexually reproduces.
- **(3) Senescent phase –** It is the time when an organism grows older and loses the reproductive capacity.

The *oestrous cycle* or *estrous cycle* (derived from Latin *oestrus* "frenzy", originally from Greek οἶστρος oîstros "gadfly") is the set of recurring physiological changes that are induced by reproductive hormones in most mammalian therian females.

Menstrual Cycle

Each month during the years between puberty and menopause, a woman's body goes through a number of changes to get it ready for a possible pregnancy. This series of hormone-driven events is called the menstrual cycle.

During each menstrual cycle, an egg develops and is released from the ovaries. The lining of the uterus builds up. If a pregnancy doesn't happen, the uterine lining sheds during a menstrual period. Then the cycle starts again.

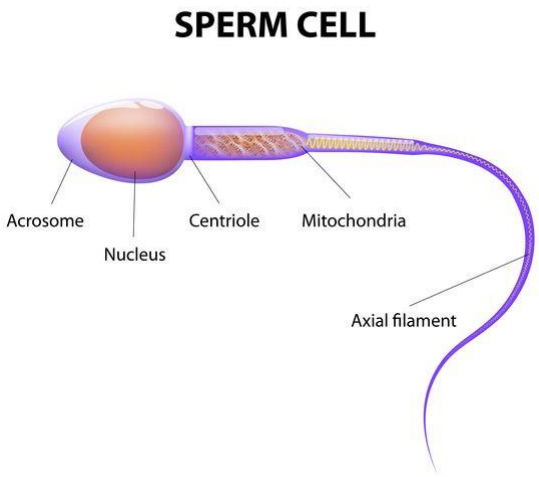
A woman's menstrual cycle is divided into four phases:

- menstrual phase
- follicular phase
- ovulation phase
- luteal phase

The length of each phase can differ from woman to woman, and it can change over time.

Stages of Sexual Reproduction

Pre-Fertilization

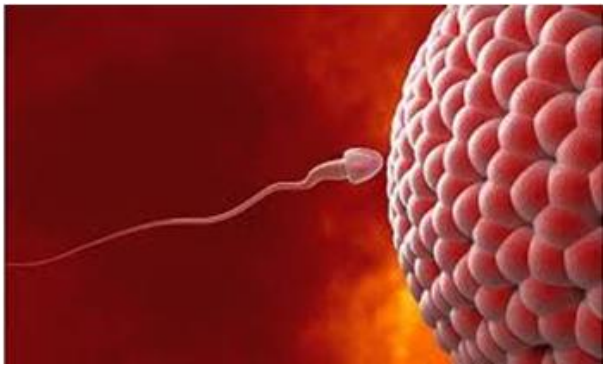


This stage involves the events prior to fertilization. Gamete formation (gametogenesis) and transfer of gamete are the two processes that take place during this stage. Gametes are sex cells, which are haploid (23 chromosomes) in nature and are distinct in males and females. The male gamete is called sperm whereas female gamete is called ovum or egg. In every

organism, these gametes are formed within special structures. Since female gamete is immobile, male gametes need to be transferred for fertilization.

In plants, this is attained by pollination. Unisexual animals transfer gametes by sexual intercourse.

Fertilization



Once the haploid male and female gametes meet and fuse together to form a zygote, this is known as fertilization or syngamy. This can occur either outside the body called external fertilization or inside the body called internal fertilization.

Post-Fertilization

Fertilization results in diploid zygote formation. Eventually, the zygote divides mitotically and develops as an embryo. This process is called embryogenesis. During embryogenesis, cell differentiates and modifies accordingly. Zygote development depends on the organism and its life cycle.

Animals are classified into oviparous and viviparous based on whether the zygote develops outside or inside the body respectively. In angiosperms, the zygote develops into the ovary and ovary transforms into the fruit while ovules develop into seeds.

monoecious and dioecious

Plants that have both female and male sexual organs or flowers called Monoecious plants. These male and female parts are located at different locations on the plant.

Example: Cucurbit, Chara and Coconut.

Unisexual plants are known as dioecious plants which do not have the female and male flowers on the one plant.

Example: Date palm, Papaya, and Marchantia.

Hermaphrodite

A **hermaphrodite** is an organism with both male and female genitalia. In sexually reproducing organisms, males have organs that produce male gametes, usually sperm. Females have different sexual organs that produce female gametes, usually called eggs.

Haploid vs Diploid

The other main difference between Haploid and Diploid cells is how they reproduce. Haploid cells are formed through meiosis and diploid cells undergo mitosis. Higher organisms such as humans (and most other mammals) are diploid organisms. The major differences are summarized below:

Difference Between Haploid And Diploid

Haploid	Diploid
Haploid cells contain only one set of Chromosomes (n).	Diploid, as the name indicates, contains 2 sets of chromosomes (2n).
Haploid cells are formed by the process of meiosis.	Diploid cells undergo mitosis.
In the higher organism, such as humans, haploid cells are only used for sex cells.	In the higher organism, such as humans, all other cells beside sex cells are diploid.
Examples of haploid cells are gametes (male or female germ cells).	Examples of diploid cells include blood cells, skin cells and muscle cells. These cells are known as somatic cells.

What is a meiocyte?

Meiocyte is a type of cell that differentiates into a gamete by the process of meiosis. It is a diploid cell. After meiosis, it divides into four genetically different haploid spores (meiospores).

Pollination

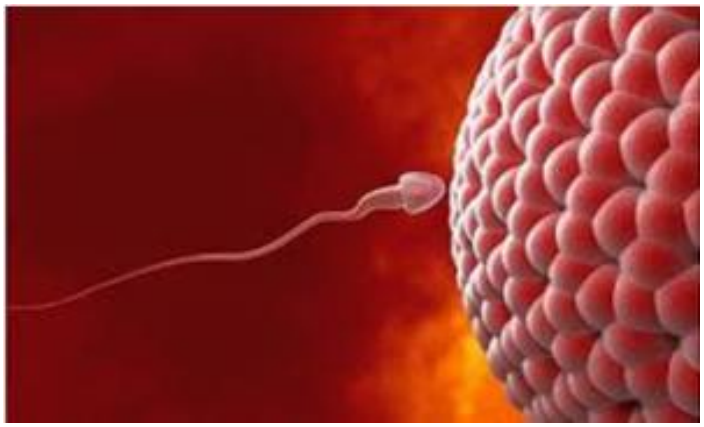
Pollination is the act of transferring pollen grains from the male anther of a flower to the female stigma. The goal of every living organism, including plants, is to create offspring for the next generation. One of the ways that plants can produce offspring is by making seeds.

Fertilization

The action or process of fertilizing an egg or a female animal or plant, involving the fusion of male and female gametes to form a zygote.

Fertilization in Animals

The process of fusion of sperm with egg (ovum) to produce zygote is called fertilization. It is the crucial and primary stage of sexual reproduction. During sexual intercourse, the penis ejaculates millions of sperms into the vagina of the woman. Sperms will travel through the uterus to oviducts. At oviduct, one out of million sperms fertilizes the released ovum. The fertilized egg develops into a zygote. Without the fusion of gametes, sexual reproduction is futile. It doesn't occur in asexual reproduction.



Fertilization in most of the animals is similar to that in humans. Animals also produce gametes for fusion. But the fusion of gametes may take place inside or outside the body. Based on this, fertilization is of two types – internal and external fertilization.

Internal Fertilization

In sexual reproduction, the male inserts the sperms into the female reproductive tract to fuse with the egg. If the fusion takes place within the female parent, it is called internal fertilization. In humans, most of the animals like cats, lions, pigs, dogs, hens, etc., the fusion of gametes takes place internally. In this type, a zygote is formed within the mother and gets its nourishment from her.

External Fertilization

When the fusion of sperm and egg takes place outside the female parent, it is called external fertilization. Only a minority of organisms exhibit this type of gamete fusion. For example, fish, frogs, etc. Here the female parent deposits her eggs in a place and later, the male parent ejects his sperms over them, then fusion takes place.

Gametes that fuse externally have to face many challenges. Since eggs and sperms are deposited in the external environment, the chances of fusion are very less. Predators may eat eggs and the zygote that is formed. To compensate for this loss, organisms like fish and frogs lay hundreds of eggs at a time.

Syngamy

The fusion of male and female gametes during the fertilization is known as *syngamy*.

Parthenogenesis

Parthenogenesis, a reproductive strategy that involves development of a female (rarely a male) gamete (sex cell) without fertilization. It occurs commonly among lower plants and invertebrate animals (particularly rotifers, aphids, ants, wasps, and bees) and rarely among higher vertebrates. An egg produced parthenogenetically may be either haploid (i.e., with one set of dissimilar chromosomes) or diploid (i.e., with a paired set of chromosomes). Parthenogenic species may be obligate (that is, incapable of sexual reproduction) or facultative (that is, capable of switching between parthenogenesis and sexual reproduction depending upon environmental conditions). The term *parthenogenesis* is taken from the Greek words *parthenos*, meaning "virgin," and *genesis*, meaning "origin." More than 2,000 species are thought to reproduce parthenogenically

Parthenocarpy

"Parthenocarpy is the production of fruits without the fertilisation of ovules. Fruits like banana and figs are developed without fertilisation and do not produce any viable seeds."

Viviparous Animals

Animals that give birth to offspring are called viviparous. In viviparous animals, both fertilization, as well as the development of the embryo, takes place inside the **female reproductive system.** Once the fetus development is complete, the mother delivers the baby. This condition is referred to as matrotrophy where the embryo obtains the nutrients directly from the mother and not the yolk.

Examples of Viviparous Animals

Human beings, dogs, cats, elephants, etc are few examples of viviparous animals.

Oviparous Animals

Animals that lay eggs are called oviparous. In oviparous animals, fertilization takes place internally but embryo development takes place externally.

The eggs of birds such as hen and duck carry immature embryo in them. The hard shells of eggs protect them from damage. Once the fetus is matured, the egg hatches. The trait of egg-laying animals is known as oviparity.

Examples of Oviparous Animals

All birds lay eggs with a typical hard calcium shell. Frogs are egg-laying amphibians which have soft gelatinous eggs requiring constant hydration. Almost all fishes are oviparous. Except for some species of snakes, all other reptiles are oviparous. In mammals, Echidna and platypus are egg-laying.

Botanically, a fruit is the seed-bearing structure in flowering plants also known as angiosperms formed from the ovary after flowering. However, in some fruits, it is not the ovary that forms the fruit. In fact, some other part of the flower, like the thalamus, inflorescence, and calyx are modified to become a part of the fruit. In this regard, fruits are classified as either **true or false fruits** depending on whether the fruit developed from a fertilized ovary or not.

True Fruit

A true fruit can be defined as the fruit which is formed from the fertilized ovary of the flower. Any true fruit will almost show the following:

- The pericarp i.e the ovary wall
- The seed or seeds i.e the fertilized and ripen ovules
- The remains of style and stigma or scar where these have been detached.

Examples of true fruits are:

- Mango,
- Kiwi fruit,
- Blueberry,
- Plums,
- Peaches,
- Pears,
- Watermelon,
- Cherry,
- Orange,
- Raspberry,
- Maize,
- Grape etc

What You Need To Know About True Fruit

1. True fruit to a fruit in which all tissues are derived from a ripened ovary and its contents.
2. True fruit can be simple fruits, aggregate fruits and multiple fruits.
3. True fruit is also referred to as *Eucarp*.
4. Fertilized ovary is the only part of the plant involved in forming the fruit.
5. True fruit develop from the mature and ripened ovary.
6. True fruit forms after fertilization
7. True fruits contain seeds

False fruit

A false fruit is defined as the fruit which is formed from the ripened ovary along with some other parts of flower like the base or receptacle, the perianth, thalamus, inflorescence or calyx. Examples of false fruits are cashew-nut which develops from the peduncle, apple, pear, gourd and cucumber which develops from the thalamus, jack fruit and pineapple which develops from the entire inflorescence. Other includes:

- Banana
- Strawberry
- Mulberry
- Banana
- Syzygium jambos
- Figs

What You Need To Know About False Fruit

1. False fruit refers to a fruit formed from other parts of the plant as well as the ovary, especially the receptacle.
2. Ovules get transformed into seeds. True fruits are made up of two parts namely, pericarp and the seed.
3. False fruit is also referred to as Pseudo-carp, Parthenocarpic fruit or accessory fruit.
4. Parts of the plant involved in fruit formation are floral parts such as thalamus, peduncle and perianth.
5. False fruits arise from other floral parts except the ovary.
6. False fruit develops without fertilization
7. False fruit is Parthenocarpic in nature and does not contain seeds