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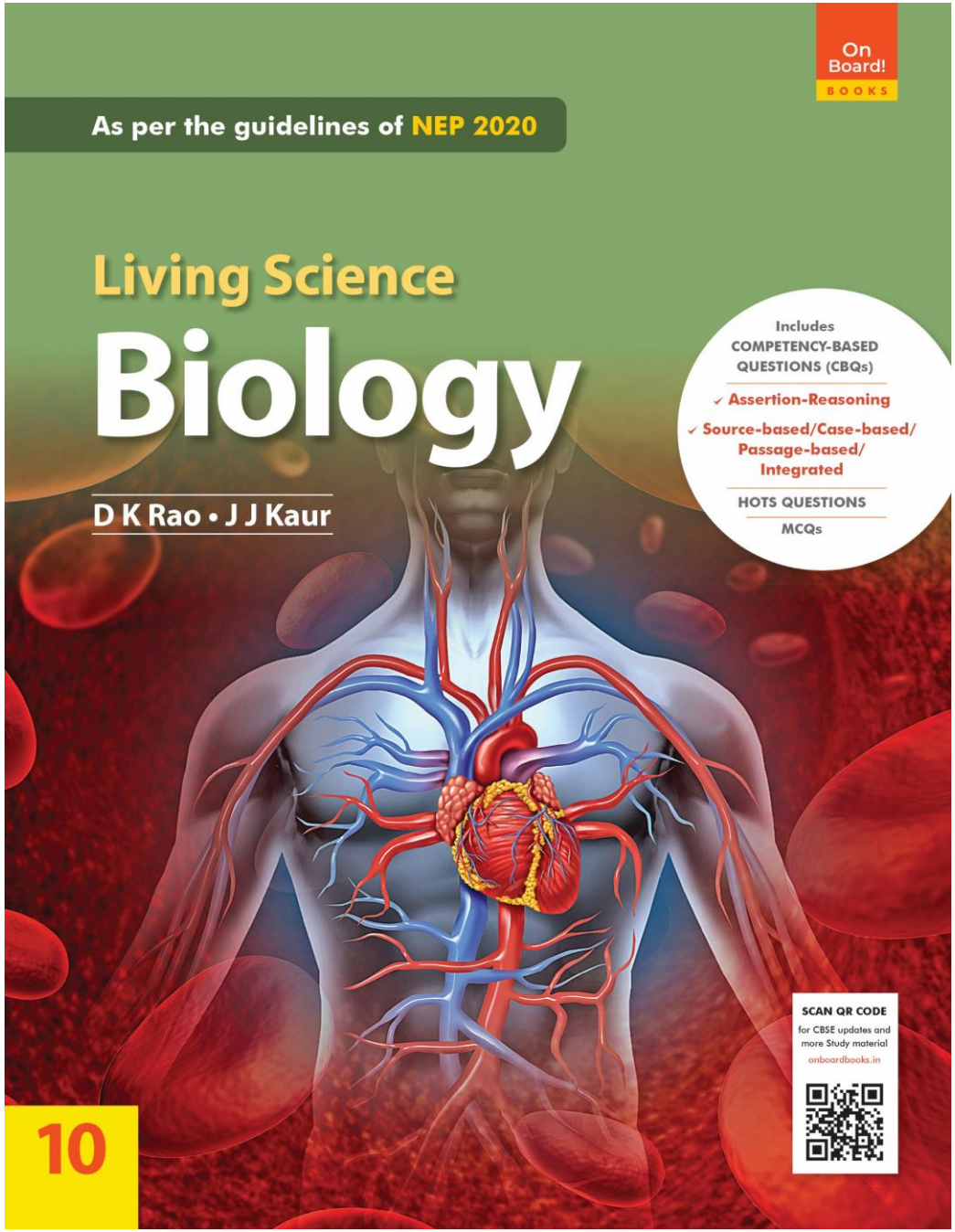
Board!
BOOKS


On Board! BOOKS
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Living Science
Biology
D K Rao • J J Kaur
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CBSE
Living Science
Biology

Class 10

Chapter 3 Reproduction in Plants and Animals

LEARNING OBJECTIVES

What is Reproduction?

- ❖ Advantages of Reproduction

Types of Reproduction

- ❖Asexual reproduction
- ❖ Types of asexual reproduction

Vegetative Propagation

- ❖ Vegetative propagation by natural methods
- ❖ Vegetative propagation by artificial methods

Sexual Reproduction

- ❖ Sexual reproduction in flowering plants

Pollination

- ❖ Self-pollination
- ❖ Cross-pollination

Fertilization and development of the seed

- ❖ Germination of the seed

Reproductive System in Human Beings

- ❖ Male reproductive system
- ❖ female reproductive system

What Happens when the Egg is not Fertilised

- ❖ Menstrual cycle

Fertilization, Pregnancy, and Development of the Embryo

- ❖ Birth control

Sexually Transmitted Diseases

What is Reproduction?

Reproduction can be defined as a process by which a living organism is able to produce more of its own kind.

Types of Reproduction

There are two types of reproduction in living organisms – asexual reproduction and sexual reproduction.

Asexual Reproduction

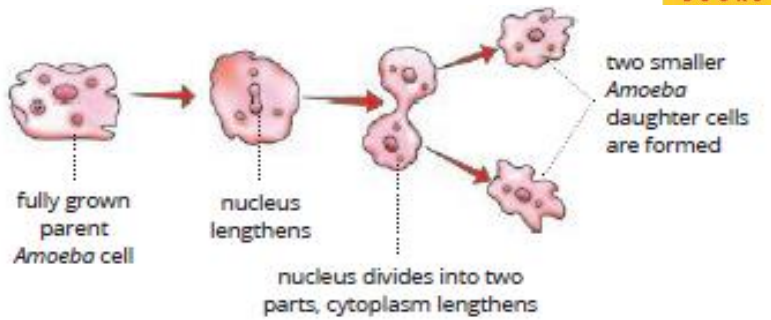
Asexual reproduction is the production of an offspring (new progeny) from a single parent without the fusion of gametes (sex cells).
There are many types of asexual reproduction.

Fission

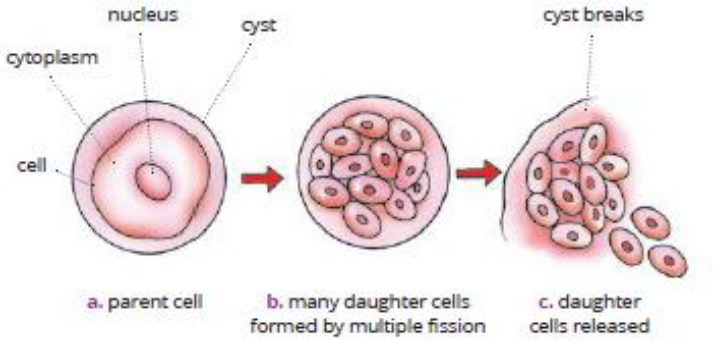
In fission, a unicellular organism splits into two or more organisms. It is common in unicellular organisms, like *Amoeba*, *Paramecium*, and *Euglena*. Fission is of two types – binary fission and multiple fission.

Binary fission: *Binary* means *two* and *fission* means *splitting*. Thus, binary fission means splitting into two, in which, the parent organism splits into two halves (two new organisms). Thus, two individuals are formed from a single parent in **binary fission**. In this type of reproduction, the nucleus first divides into two nuclei, which is followed by the division of cytoplasm.

The cell finally splits into two **daughter cells**. The two daughter cells grow fully and divide again.



Binary fission in *Amoeba*

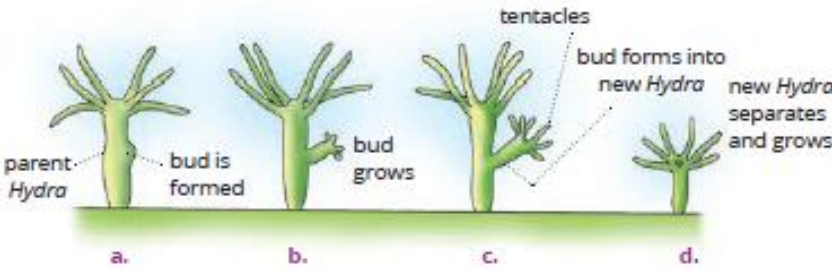


Multiple fission in *Plasmodium*

Multiple fission: Another type of fission in which many individuals are formed from splitting of a single parent, is called multiple fission.

Budding

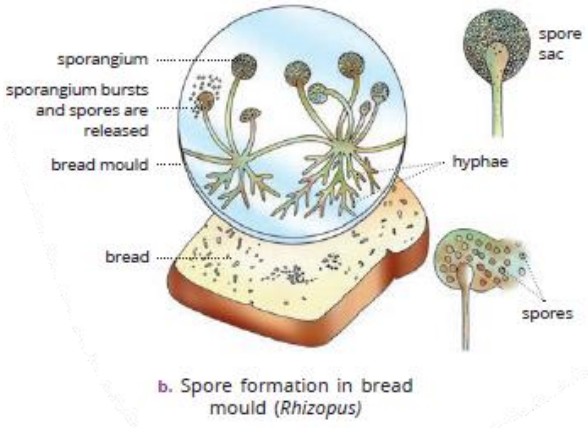
In this type of asexual reproduction, a bulb-like projection or outgrowth arises from the parent body known as bud which detaches and grows to form a new organism.



Budding in *Hydra*

Spore formation

Spore formation is a common method of asexual reproduction in lower organisms. A spore is a resting state in which the cell is protected by a thick wall during unfavourable conditions.

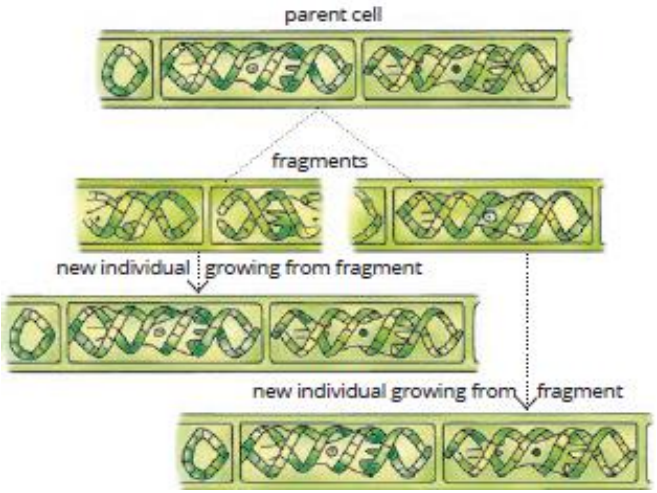


b. Spore formation in bread mould (*Rhizopus*)

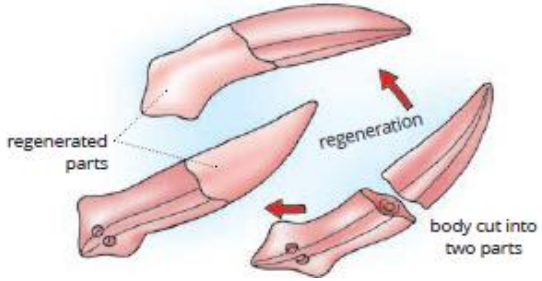
Penicillium, and non-flowering plants like mosses and ferns also reproduce through spore formation

Fragmentation

Breaking up of the body of simple multicellular organisms into fragments or pieces such that each of the piece grows to form a new organism is called fragmentation. Filamentous algae, like *Spirogyra*, reproduce by this method.



Reproduction by fragmentation in *Spirogyra*



Regeneration in *Planaria*

Regeneration

Some animals like *Hydra*, flatworms and sponges, when cut into pieces, each piece is capable of growing into an entire individual. This is known as regeneration. Thus, the ability of an organism to replace its lost body part(s) by regrowth is known as regeneration.

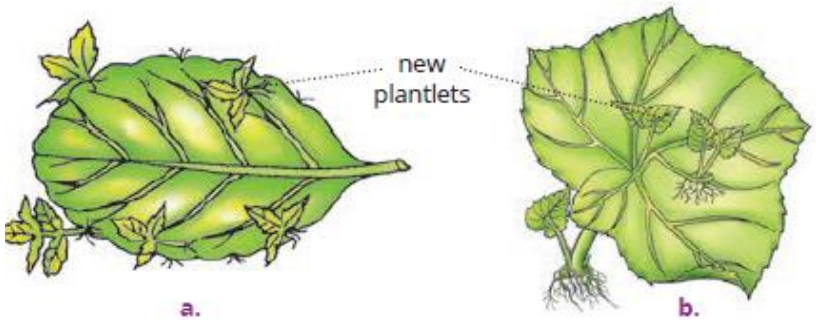
Vegetative Propagation

Vegetative propagation (or vegetative reproduction) is a form of asexual reproduction in which parts of the old plant like stems, roots and leaves grow and develop into a new plant without the help of any reproductive organ. Vegetative propagation can occur by natural methods as well as by artificial methods.

Vegetative Propagation by Natural Methods

Vegetative propagation by adventitious buds on leaves – *Bryophyllum*

Some plants such as *Bryophyllum*, *Begonia* and mint produce adventitious buds on the margin of their leaves. When the leaf falls on moist soil, these buds develop into small plantlets. These plantlets get separated and grow into independent plants, thus promoting vegetative propagation.



Vegetative propagation by leaf in **a.** *Bryophyllum* and **b.** *Begonia*

Vegetative propagation by stems

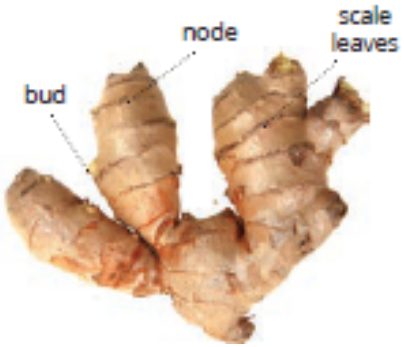
The stem is a very efficient means of vegetative reproduction. In many perennial plants, the stem develops buds on it. For example, tuber of potato, rhizome of ginger, bulb of onion, corm of *Colocasia*, etc.

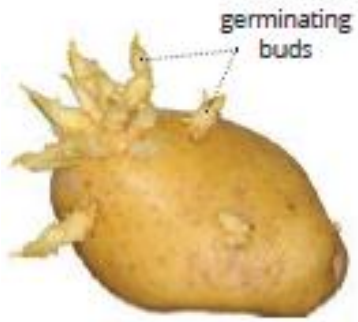
Vegetative propagation by underground stems

Rhizome (ginger): A short, swollen and underground stem that bears buds and adventitious roots is called rhizome. A new plant develops from the buds of rhizome, e.g. ginger.

Tuber (potato): A swollen underground stem that bears axillary buds in the axils of scale leaves present on them is called tuber. These scales are known as ‘scars’ or ‘eyes’. Each bud on tuber is capable of growing into a new plant, e.g. potato.

Vegetative propagation by rhizome in ginger





Vegetative propagation by tuber in potato

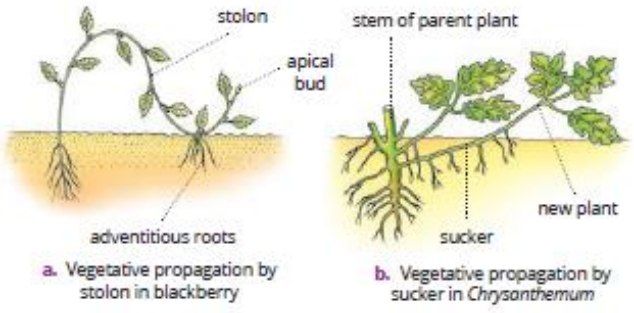
Vegetative propagation by sub-aerial and aerial stems

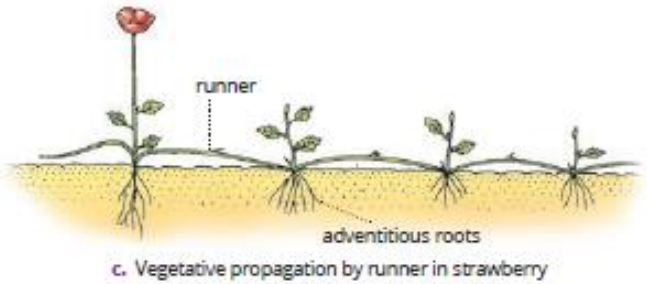
The aerial and sub-aerial stems also reproduce vegetatively. For example, blackberry, mint, pineapple and strawberry reproduce by this method.

Vegetative propagation by roots

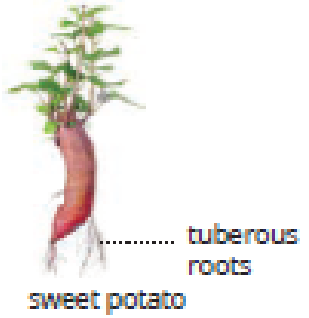
The roots of sweet potato, guava and mint bear adventitious buds.

The roots of carrot, turnip and radish bear buds at the base of old stem that serve as an organ of vegetative propagation.





Vegetative propagation by sub-aerial and aerial stems



Vegetative propagation by root in sweet potato

Vegetative Propagation by Artificial Methods

Besides the natural methods of vegetative propagation, several artificial methods of plant propagation are also used by gardeners, farmers and horticulturists. These methods include cutting, layering, grafting and tissue culture technique.

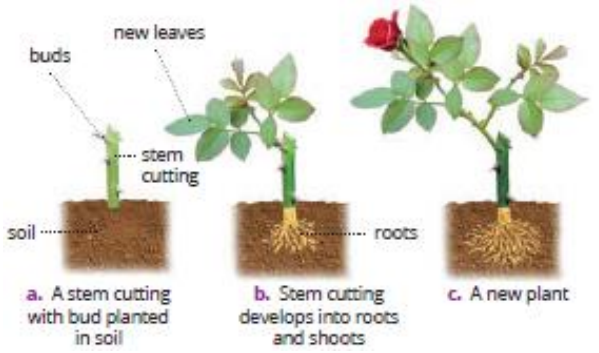
Cutting

It is a very common method of vegetative propagation in plants like rose, grapes, sugar cane, banana, potato and *Bougainvillea*. Stem cutting, root cutting as well as leaf cutting are some methods for vegetative propagation.

Stem cutting: Plants like potato, rose, sugar cane, banana can be grown through stem cuttings

Root cutting: In this method, commonly used in plants like tamarind and blackberry, roots are cut into pieces of 7–10 cm and placed in moist soil in horizontal position. Soon the roots and shoots develop from these cuttings and new plants are formed.

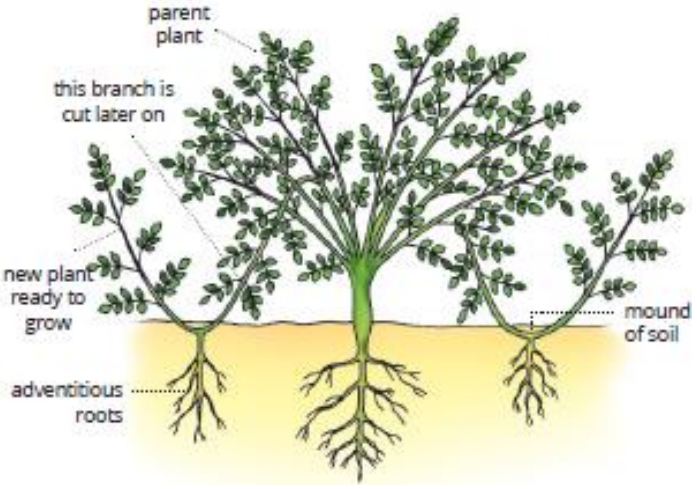
Leaf cutting : Plants like *Begonia* and *Peperomia* having succulent leaves are propagated by leaf cuttings.



Layering

Layering is the process of development of roots on a stem while it is still attached to the parent plant.

Mound layering: This can be done by bending the branch to the ground and covering it with moist soil. The apical portion of this branch is in air which develops leaves. The part below the soil develops adventitious roots. The layer branch is then cut from the parent plant and it grows into an independent plant. Layering is practised in plants like jasmine (*Jasminum*) and *Magnolia*.

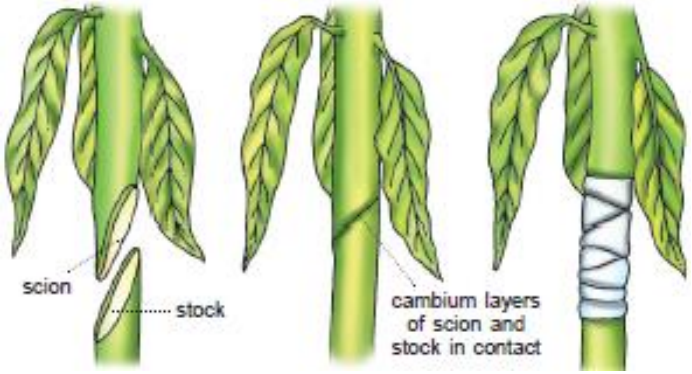


Vegetative propagation by mound layering in jasmine (*chameli*)

Air layering or gootee: This is used in plants having thick branches that cannot be bent easily. In such plants, the stem is gashed or half cut with a sterilized knife or the bark around the stem is removed (about 1 inch) and then moss is wrapped around the cut or exposed portion of the stem. This moss is then moistened with water and covered with a polythene film.

Air layering in a rubber plant

This stem is then cut from the parent plant and then grown separately. Plants like rubber and *litchi* can be propagated using this method.



Grafting in a mango tree

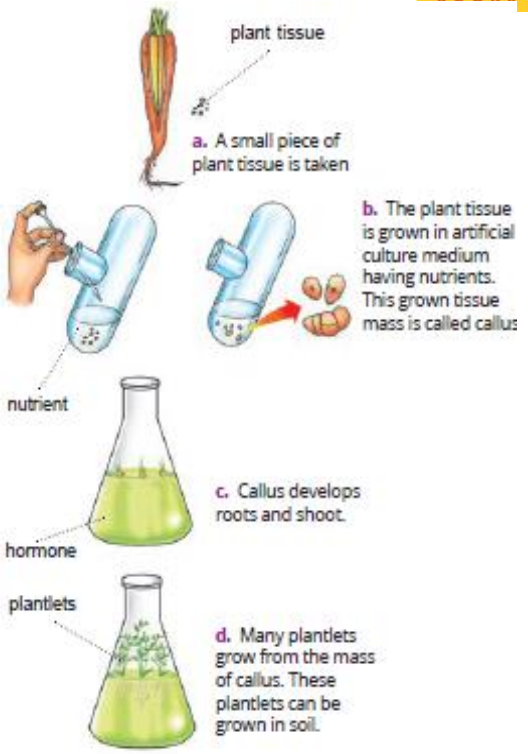
Grafting

Grafting is the method of obtaining a superior quality plant from two different plants by taking the root system of one plant and the shoot system of another. The plant whose root system is taken is called **stock** while the plant whose shoot system (without root) is taken is called **scion**

Tissue culture – micropropagation

Tissue culture is a modern technique of vegetative propagation. This technique is also called **micropropagation**.

In this technique, a small part of tissue is cut from a plant and grown in a container containing artificial nutrient medium under aseptic conditions (free of microbes). The tissue utilizes nutrients from the medium, proliferates and forms an unorganized, undifferentiated mass of cells called **callus**. Small portion of this callus is separated and transferred to another medium containing hormones. These hormones or growth regulators induce differentiation and plantlets are produced. These plantlets are transplanted into the soil, which grow into mature plants . *Orchids*, *Asparagus*, *Chrysanthemum* and many other plants are now being grown by using tissue culture technique.



Tissue culture or micropropagation in plants

Sexual Reproduction

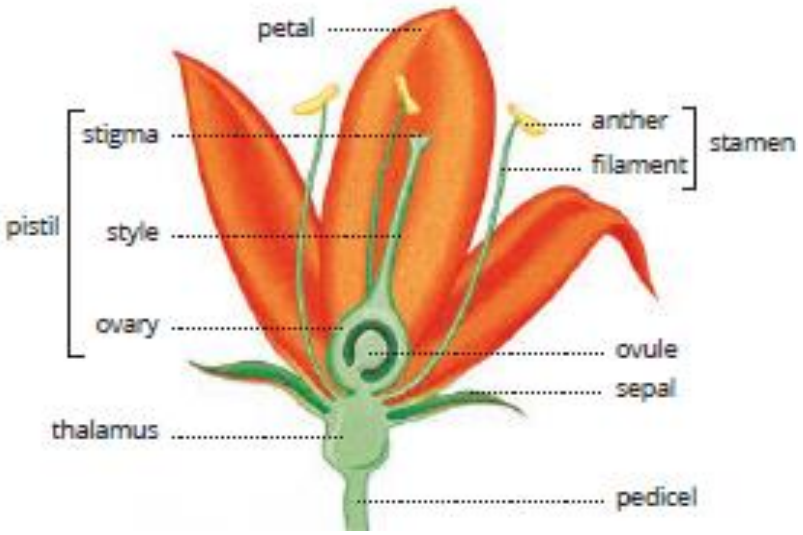
Sexual reproduction is the process in which male sex cell (sperm) fuses with female sex cell (ovum) to form a new cell called zygote. The sex cells are often called gametes or germ cells.

Sexual Reproduction in Flowering Plants

Sexual reproduction is the most common method of reproduction in flowering plants. Seeds are produced as a result of sexual reproduction. New plants are produced from these seeds.

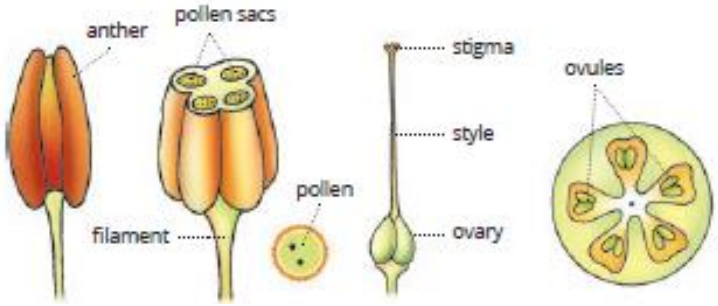
Structure of a typical flower

A typical flower has four whorls – **calyx (sepals)**, **corolla (petals)**, **androecium (stamens)** and **gynoecium (carpels)**. The inner two whorls are directly concerned with sexual reproduction, hence, these two whorls are called **reproductive whorls** or **essential whorls**.



Androecium (stamens) and gynoecium (carpels) are the reproductive parts of the flower. The androecium constitutes the male part of the flower. It is a collection of the male reproductive organs of the flower called **stamens** . Each stamen has an upper part called **anther** and a slender stalk called **filament**. The anther possesses four **pollen sacs** and each pollen sac contains many **pollen grains** which are usually yellowish in colour.

Gynoecium or carpel is the innermost whorl of a flower which lies in its centre. **It is the female reproductive part of a flower.** Carpel is also known as a **pistil**. Each pistil consists of three parts – an upper, sticky flat part **stigma**, a medial, long, cylindrical part **style** and a lower, swollen part **ovary**.



Ovules are the structures in which embryo sacs or egg cells develop, and mature into seeds after fertilization. The arrangement of ovules in the ovary is called **placentation**. The flowers containing only one sex organ (stamen or carpel) are called **unisexual flowers**, for example, flowers of papaya and watermelon. The flowers containing both the sex organs are called **bisexual flowers**, for example, flowers of mustard and *Hibiscus*.

Pollination

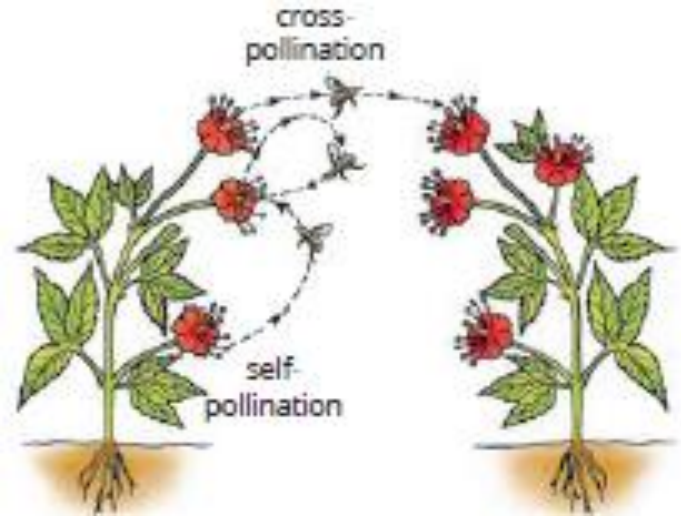
The pollen must be transferred from the anther, where it is produced, to the stigma where it germinates forming a pollen tube. This is known as pollination. Pollination is the transfer of pollen grains from the anther of a stamen to the stigma of a carpel.

Self-pollination

The transfer of pollen grains from the anther to the stigma of the same flower, or to the stigma of another flower on the same plant is known as self-pollination.

Cross-pollination

The transfer of pollen grains from the anther of a flower of one plant to the stigma of a flower of another plant of the same species is called cross-pollination.



Self-pollination and cross-pollination

Fertilization and Development of the Seed

There are various steps in fertilization and development of the seed.

Pollination brings female and male gametophytes together

For the egg to be fertilized, the male and the female gametophytes must meet and unite their gametes. This is done by pollination, in which pollen grains are deposited on the stigma of the carpel.

❖ Under suitable conditions, the cytoplasm of the pollen grain absorbs sugar and water from the stigma and bulges out to produce a tube known as **pollen tube**.

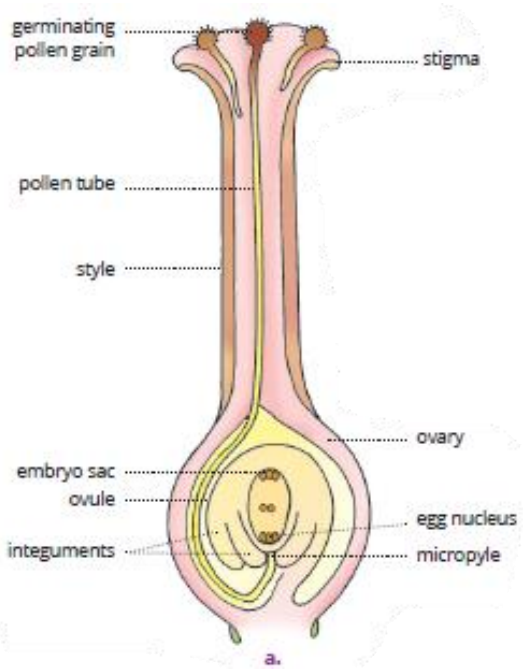
This tube grows down through the stigma and style towards the ovary. The tip of the pollen tube enters the ovary through micropyle end.

❖ The nucleus of the pollen grain divides by mitosis and forms two male gametes. The pollen grain, with a tube containing two male gametes, forms the mature **male gametophyte**. The ovule contains the egg cell inside the embryo sac.

❖The tip of the pollen tube after entering ovary ruptures and discharges the two male gametes into the embryo sac.

❖ One of the male gametes fuses with the egg to form the zygote. This fusion is called **fertilization.** Another male gamete fuses with secondary nucleus and forms the **endosperm**, a food storing tissue.

❖ The zygote divides several times and forms an embryo.



Process of fertilisation

The ovule develops into a seed, an embryo with a supply of nutrients in the seed coat

The ovule develops into a seed. After fertilization, the zygote divides many times to form an embryo within the ovule. The ovule develops a tough coat and is gradually converted into a seed.

The embryo contains a tiny root (**radicle**), a future shoot (**plumule)** and cotyledons. Cotyledons contain food reserves.

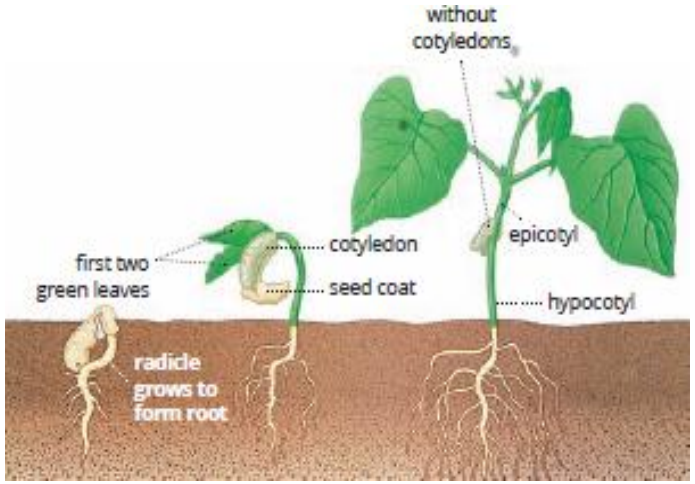
The ovary develops into a fruit

The whole ovary after fertilization develops into a fruit, which protects the enclosed seed. **The ovary wall ripens and forms the pericarp of the fruit.** There may be one or more seeds in a fruit. The fruit after dehiscence (breaking open) releases the seeds.

The embryo lies dormant in the seed. At the onset of favourable conditions, it becomes active and germinates into a small seedling through a seed germination process.

Germination of seed

A seed is the reproductive part of a plant which is capable of growing into a new plant. First, the radicle grows to form the root. The root pushes down into the soil for absorbing water and mineral nutrients. Then, the plumule grows to form the shoot. When it comes out of the ground, green leaves develop from the cotyledons and finally it grows into a new plant.

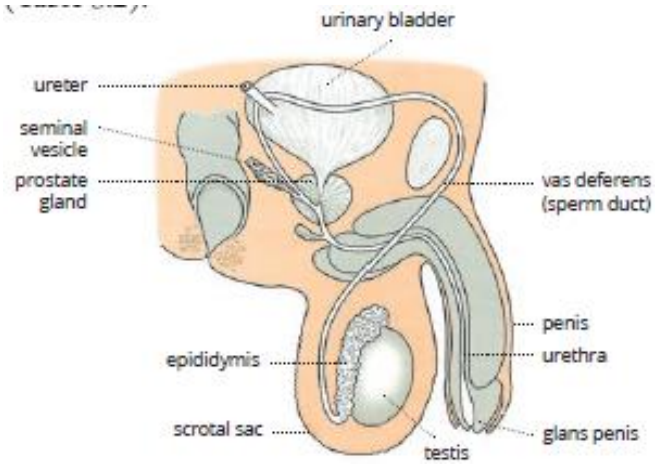


Reproductive System in Human Beings

The reproductive organs in human beings become functional after attaining sexual maturity. **The period during adolescence in which the body attains sexual maturity is called puberty.** Puberty tends to be reached early in girls (females) than boys (males). In males, sexual maturity is attained at an age of 13–14 years. In females, it is attained at an age of 11–12 years. This age is known as the age of puberty.

Male Reproductive System

The male reproductive system consists of the following organs – a pair of testes, a pair of epididymis, a pair of vasa deferentia, urethra, peni and accessory glands .



Testes

Testes (*singular:* testis) are the **male gonads**. The transverse section of testis shows that each testis has several highly coiled tubules called **seminiferous tubules** which are involved in the formation of spermatozoa.

Epididymis

It is a long tube about 6 m long, highly coiled, that remains attached to the testis and lies within the scrotal sac.

It stores sperms till they become mature and motile and serves as a passage for their transport from the testis.

Vas deferens (sperm ducts)

Each epididymis continues from its lower end as a vas deferens . It joins the duct of seminal vesicle to form the ejaculatory duct. The ejaculatory duct opens into the urethra.

Urethra

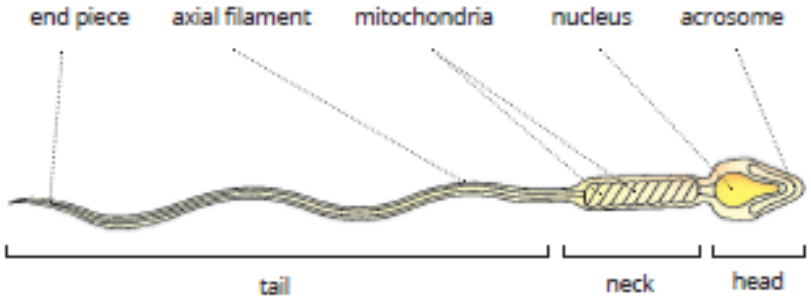
The male urethra is about 15–20 cm in length. It functions as a common passage for both semen and urine.

Penis

Penis is the **copulatory organ** in males. It is a cylindrical and muscular organ. The urethra runs through it centrally and serves as a common passage for the exit of urine and semen.

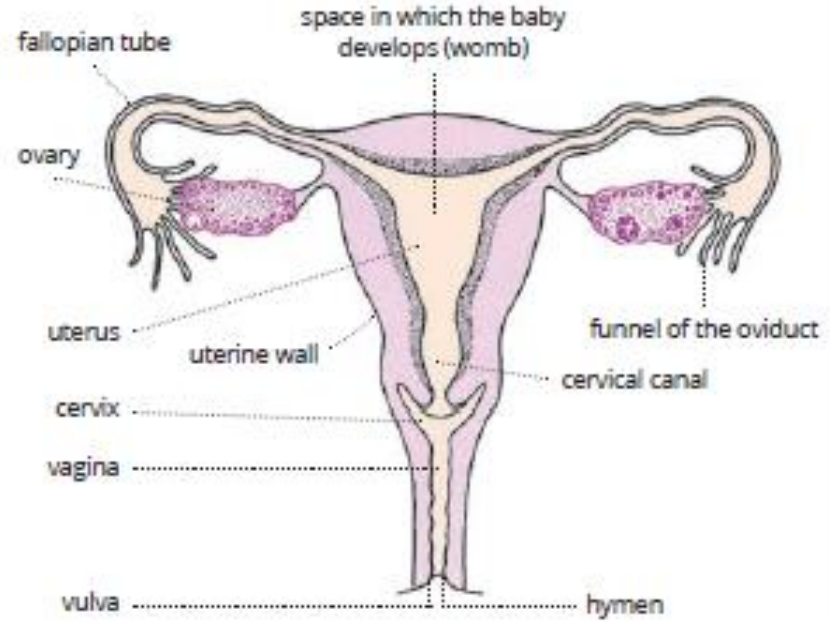
Spermatozoa and semen

The spermatozoa are minute gametes produced by the testes in males. The secretions of various accessory glands along with sperms form the semen.



Female Reproductive System

The female reproductive system consists of the following organs – a pair of ovaries, a pair of fallopian tubes, uterus, vagina and external genitalia.



Ovaries

A pair of almond-shaped ovaries lie in the lower part of the abdominal cavity, one on each side of the body.

Each ovary is attached to the uterus. Ovaries produce **ova** and secrete female sex hormones, **oestrogen** and **progesterone**. The process of formation of egg in the ovary is known as **oogenesis**.

Fallopian tubes (oviducts)

There are two oviducts or fallopian tubes, about 10–15 cm long, in the human female reproductive system. Each oviduct continues as a thin and coiled tube and opens into the uterus at the other end.

Uterus

The uterus is a pear-shaped, muscular, thick-walled organ. The uterus in human female is about 7 cm long, 5 cm broad and 2.5 cm thick.

Vagina

It is a muscular tube about 7–10 cm in length. Vagina is the organ where sperms enter during sexual intercourse. It serves as the **birth canal** during childbirth and also acts as a duct for the passage of uterine secretions and menstrual flow.

Menstrual cycle (menstruation)

In a human female, the fertility period extends from the age of puberty, i.e. about 11–12 years up to menopause, i.e. 45–50 years. The stage of puberty is marked by the appearance of secondary sexual characteristics and the commencement of menstruation. At the time of **menopause**, ovulation and menstruation stop and the reproductive organs decrease in size.
Between puberty and menopause, the female reproductive system passes through a regular monthly sequence of events called the **menstrual cycle.**

Fertilization, Pregnancy and Development of the Embryo

Fertilization

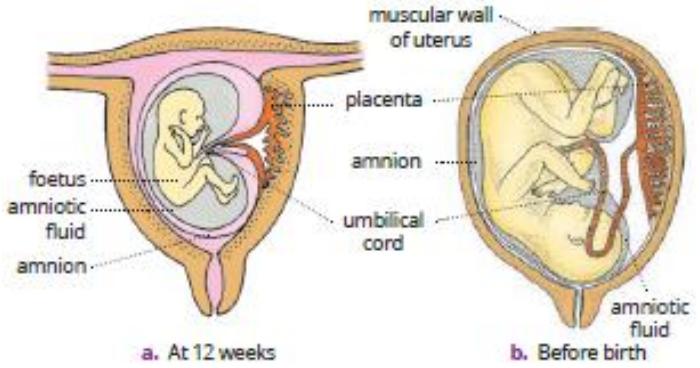
Once the sperms are deposited in the vagina, they must travel towards the ovum through the fallopian tube. In the fallopian tube if the ovum receives a sperm, they unite to form a zygote. This is called fertilization. Fertilization occurs in the fallopian tube.

Implantation

The zygote immediately begins to divide and forms a mass of cells called **morula**. It passes down to the uterus and fixes itself to the wall of the uterus. This fixing of morula in the wall of the uterus is called **implantation** and the female is said to be pregnant or in the stage of **pregnancy**. Implantation takes place about a week after fertilization.

Placenta

The developing **embryo** is attached to the uterus by a tissue called **placenta**. It is the physiological connection between the developing embryo and the mother's uterine wall. **Umbilical cord** is a tough structure that serves as the blood vascular connection between the foetus and uterine wall.



From the first few weeks of development, the embryo is enclosed in a sac called **amnion** which is filled with **amniotic fluid**. This fluid acts as a shock-absorber and helps to protect the embryo from damage.

Placenta serves as a tissue through which oxygen and food are supplied from the maternal blood to the foetus. It also transports carbon dioxide and excretory waste from the foetal blood to the maternal blood.

Birth Control

An unchecked population growth leads to population explosion. It is a matter of deep concern and it has become very essential to limit human population. There are various ways to prevent fertilization and hence to avoid unwanted pregnancy. The most effective method is to impart education to the masses about various ways of fertility control.

Preventive methods

These methods prevent the fusion of the egg and the sperm.

Note: Refer to Table 3.4 for Main methods of contraception

Sexually Transmitted Diseases

Sexually transmitted diseases (STDs) are the diseases which are transmitted from an infected person to a healthy person during a sexual intercourse. STDs can be bacterial or viral. Gonorrhoea and syphilis are the bacterial diseases, and warts and HIV-AIDS are the viral infections.

Prevention and control

1. Responsible sexual behaviour 2. Avoiding multiple sex partners
3. Using a condom or other barrier method of contraception
4. Screening of blood before transfusion 5. Avoiding sharing of needles
6. Using disposable syringes and needles 7. Educating people

SUMMARY...

❖ Reproduction maintains continuity of life. It is the process by which living organisms give rise to new individuals of the same species. There are two modes of reproduction – asexual and sexual.

❖ In asexual reproduction, only one organism is involved. No gametes are produced and no fertilization takes place.

❖ In sexual reproduction, both male and female gametes are united and the process of fertilization takes place.

❖ Fission, budding, regeneration, fragmentation and spore formation are a few methods of asexual reproduction in lower organisms.

❖ Vegetative propagation is a form of asexual reproduction in plants in which a bud grows from any part of the parent plant body and develops into a new plant.

❖ In vegetative propagation, a vegetative part of the plant body like leaf, stem or root develops into a complete new plant.

❖ Several artificial methods of plant propagation like grafting, cutting, layering and tissue culture are used for propagation of plants in gardens and nurseries.

❖ Pollination is the transfer of pollen grains from the anther to the stigma of the same flower or of a different flower. Pollination is of two types – self-pollination and cross-pollination.

❖ Self-pollination is the transfer of pollen grains from the anther to the stigma of the same flower or of another flower of the same plant. Self-pollination has both advantages and disadvantages.

❖ The transfer of pollen grains from anther of flower of one plant to the stigma of a flower of another plant of the same species is called cross-pollination.

❖ In flowering plants, after fertilization, ovary changes into fruit, ovules become seeds, and other floral parts dry and fall off.

❖ The age of 13–14 years in males and 11–12 years in females is called puberty in human beings.

❖ Between puberty and menopause, the female reproductive system passes through a regular monthly sequence of events called the menstrual cycle.

❖ The release of the ovum from the ovary is called ovulation. In the fallopian tube if the ovum receives a sperm they unite to form a zygote.

❖ The fixing of mass of cells (morula) in the uterine wall is called implantation.

❖ Fertility control methods can be preventive or corrective.

❖ Diseases which spread through sexual contact are known as sexually transmitted diseases.

THANK YOU