

HOW DO ORGANISMS REPRODUCE ?

Key Points



Creation of new organism from the existing organism of the same species is known as reproduction.

- ▶ Reproduction is one of the important process by which every living organism makes a copy like itself. It is the means of multiplication and perpetuation of the species.
- ▶ Reproduction at its basic level (cellular reproduction) is involved in making similar or dissimilar body designs through the genetic material (DNA) present in the chromosomes of its nucleus.
- ▶ DNA is the source of information for making proteins.
Reproduction is not an essential life process, yet it is a unique property of living beings.

Note

- ▶ DNA is the blueprint of life. It stores all the information about the body design, building and running of the cellular machinery and functioning of the individuals.

Importance of variation

- ▶ Reproduction is production of DNA copies in a reproducing cell called DNA replication.
- ▶ Variations are differences in structure, physiology and other traits found in individuals of species.

Significance of reproduction

- ▶ For maintenance of continuity of a species
- ▶ For adding variation for evolution
- ▶ For maintenance of population size

Types of reproduction

There are two types of reproduction in living organisms -

1. Asexual reproduction
2. Sexual reproduction

1. Asexual reproduction

- ▶ Production of offsprings by a single parent without the formation and fusion of gametes is called asexual reproduction.
- ▶ Primitive type of reproduction
- ▶ Offsprings are genetically identical to their parents.

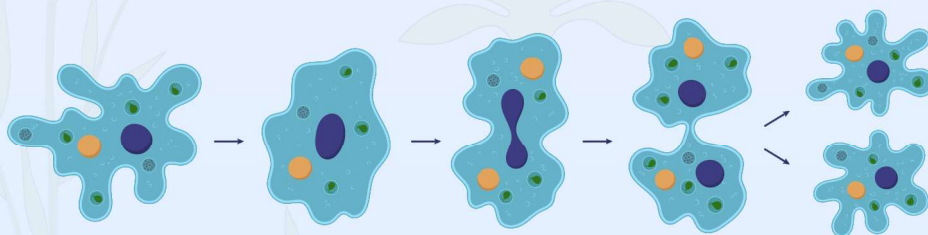
Modes of asexual reproduction

(i) Fission

Binary fission :

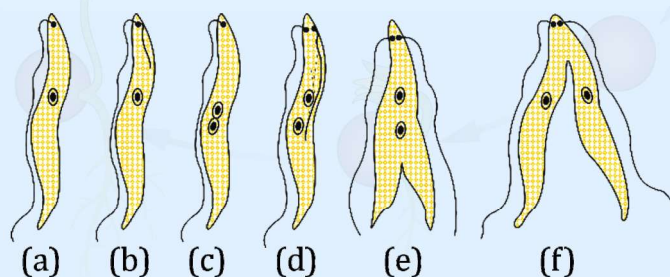
One cell splits into two equal halves, e.g., many bacteria and protozoa like *Amoeba*, *Paramecium* and *Leishmania*.

In amoeba, fission can take place in any plane.



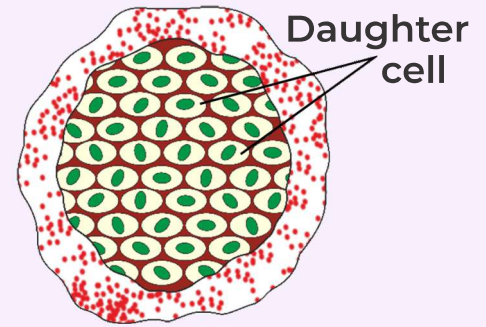
In *Leishmania*, have a whip-like structure at one end of the cell.

Such organisms, binary fission occurs in a definite orientation in relation to these structures. i.e. longitudinal binary fission.

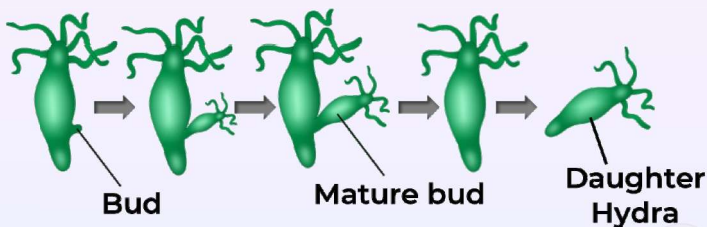


Multiple fission :

One cell divides in repeated fashion into many daughter cells simultaneously, e.g. *Plasmodium* (malarial parasite) and *Amoeba* in unfavourable conditions.



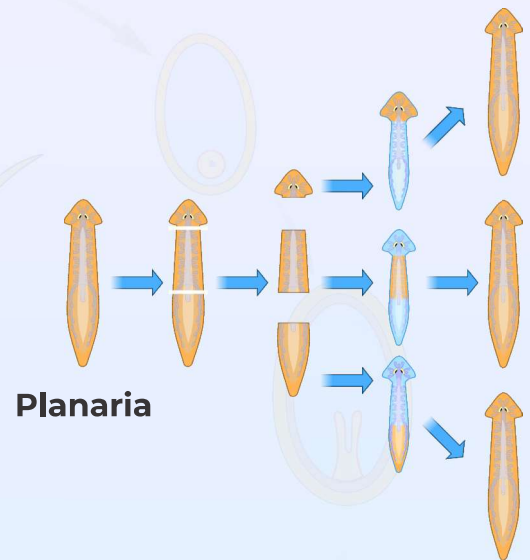
(ii) Budding



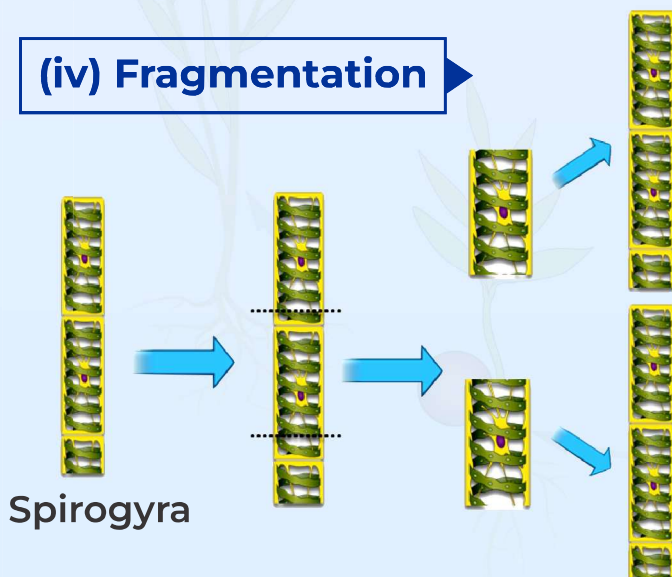
Process in which an outgrowth (bud) is formed on the body of parent organism which then detaches when fully mature and become a new independent organism e.g. *Yeast and Hydra*.

(iii) Regeneration

- ▶ The process of getting back a full organism from the body parts of the parent individual is called regeneration. e.g. *Hydra and Planaria*.
- ▶ Ability to regenerate is due to presence of stem cells.
- ▶ Regeneration is not same as reproduction.



(iv) Fragmentation



- ▶ An organism breaks up into two or more fragments and each fragment develops into an adult organism. e.g. *Spirogyra*.

(v) Spore formation



- ▶ It takes place in fungi bread mould (*Rhizopus*).
- ▶ The tiny blob- on- a- stick structures (sporangia) are involved in reproduction. Sporangia contain cells, or spores, that develops into new *Rhizopus* individuals.

(vi) Vegetative propagation

- ▶ This is an asexual method of reproduction in plants where vegetative parts namely root, stem and leaves give rise to new plants.

(a) Natural vegetative propagation :

▶ By leaves :

adventitious buds with adventitious roots on their margin, which get detached and develop into new plants.

e.g. *Bryophyllum*, *Kalanchoe*.



- ▶ **By stem :** Underground modified stems possess buds that produce aerial shoots annually under favourable conditions when planted in soil. e.g. *Potato*, *Ginger*, *Onion*.



- ▶ **By roots :** Modified tuberous roots when planted in soil, the buds present on the roots grow into leafy shoots above ground and adventitious roots at their bases. e.g. *Sweet potato*, *Dahlia*.



(b) Artificial vegetative propagation :

Cutting :

- ▶ A small part of plant (stem, root or leaf) is cut and buried partly in the moist soil, then cutting develops roots and grows into a new plant.
- ▶ Stem cutting are most commonly used for artificial vegetative propagation.
e.g. *Rose, Sugarcane, Potato, Cactus.*



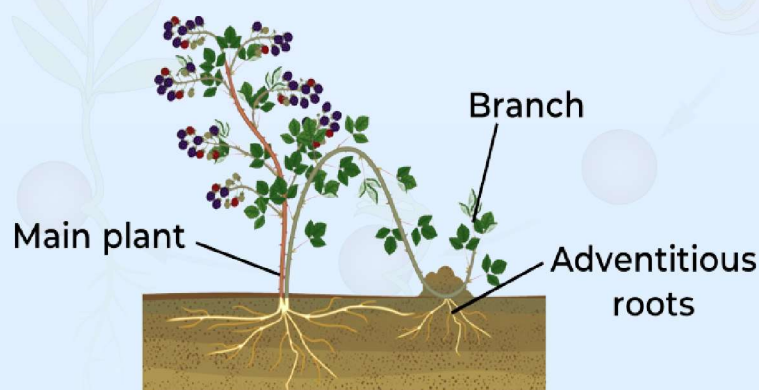
Grafting :

- ▶ Two dicotyledonous plants of closely related varieties are joined together.
- ▶ The plant of which roots remain in the soil is called as stock. Cutting part of a plant that is grafted on the other rooted plant is called scion.
e.g. *Mango, Apple, Lemon.*
- ▶ Grafting is not possible in monocot plants.



Layering :

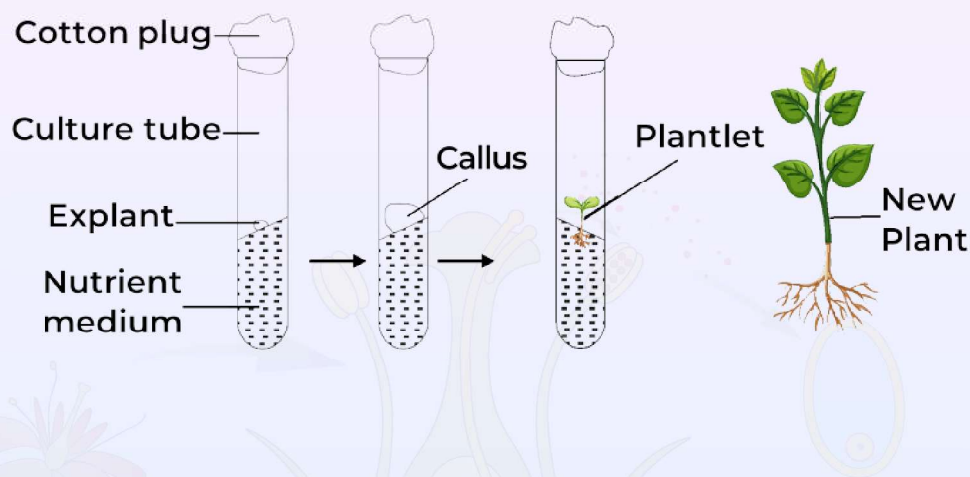
- ▶ Most common method of propagating herbaceous plants.
- ▶ In this method the lower branch of the parent plant is bent and buried in the moist soil with the growing tip of the branch remains above the soil surface.
- ▶ The portion of the branch which is in contact with the soil develops adventitious roots and this rooted branch is called layer.
e.g. *Citrus, Grapevine, Jasmine and Hibiscus.*



Tissue culture or Micropropagation :

- ▶ Isolated tissue from the growing tip of plant is called explant.
- ▶ The explant develops into undifferentiated mass of cells called callus in the proper culture medium.
- ▶ This technique is commonly used for ornamental plants.

e.g. *Orchids*, *Chrysanthemum*.



Note

Tissue culture is also called micro-propagation because a large number of plants are formed from a small tissue.

Advantages of vegetative propagation :

- ▶ It is a rapid, cheap and easy method of reproduction for the multiplication of plants.
- ▶ Disease free plants can be produced.
- ▶ Superior quality fruits or flowers can be produced by grafting.
- ▶ Genetically identical plants are produced.
- ▶ Plants raised by vegetative propagation can bear flowers and fruits earlier than those produce from seeds.
- ▶ Propagation is also possible for plants that have lost the capacity to produce seeds. e.g. banana, rose and jasmine.

Advantages of asexual reproduction :

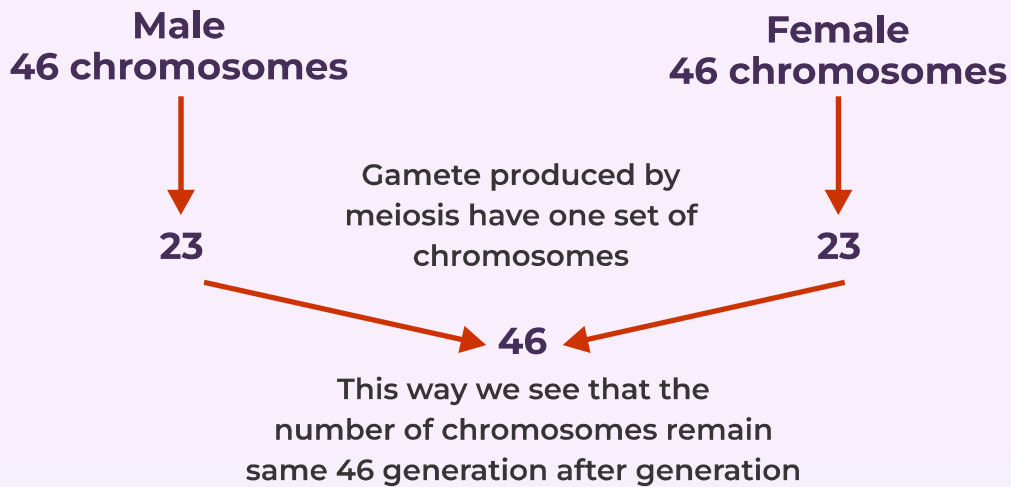
- ▶ It is only method of reproduction in most unicellular organisms.
- ▶ The parental properties are preserved.
- ▶ It is rapid method as it does not require any sexual maturation, production of gametes, transfer of gamete and their fusion.

Differences between asexual and sexual reproduction

Features	Asexual reproduction	Sexual reproduction
Number of parents involved	One	Two
Resemblance with parents	Organisms produced resemble exactly with the parent.	Organisms do not resemble exactly with the parent but resemble in certain features with both the parents.
Type of cell divisions	Amitotic / mitotic.	Mitotic and meiotic both are present.
Time duration for multiplication	Takes less time.	Takes more time.
Variations	Variations are very less.	Variations are present.
Adaptability	Organisms produced have less adaptability.	Organisms produced have more adaptability.
Examples	Fission in Amoeba, budding in Yeast.	Higher plants and Animals

2. Sexual reproduction

- ▶ Type of reproduction in which two different sex cells (gametes) participate.
- ▶ All sexually reproducing organisms have two sets of chromosomes called homologous chromosomes. One set of chromosomes come from each parent.
- ▶ The number of chromosomes are reduced to one set by a kind of cell division called meiosis in which four cells are produced each with only one set of chromosomes, which later develops into gametes.

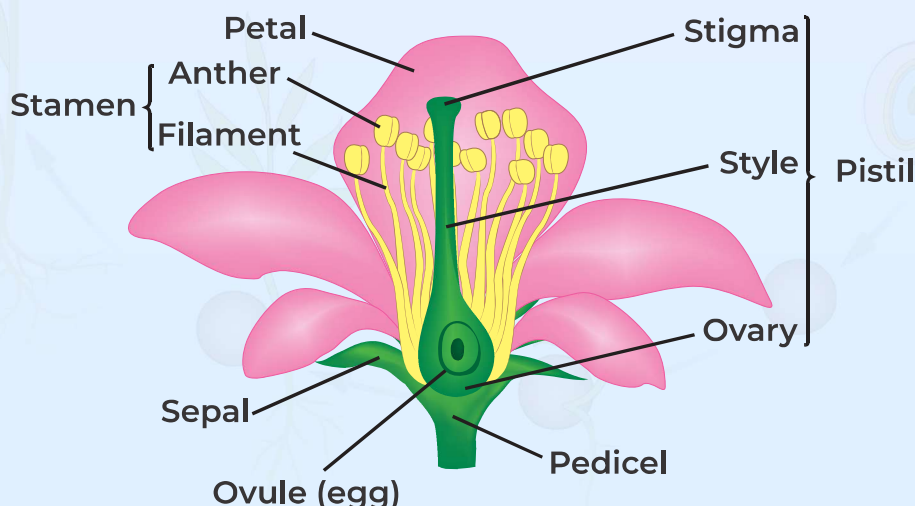


- Sexual reproduction involves following steps –
 - Formation of gametes (by meiotic cell division).
 - Fusion of gametes (Formation of zygote).
 - Development of zygote to an adult individual.

Sexual reproduction in flowering plants

- Sexual reproduction takes place within specialized reproductive organs, called flowers in angiosperms (flowering plants).
- A typical flower has four whorls arranged on the thalamus.

- | | |
|---------------|---|
| 1. Calyx | } Non-essential organs or accessory organs. |
| 2. Corolla | |
| 3. Androecium | } Essential organs or reproductive organs. |
| 4. Gynoecium | |



1 Calyx

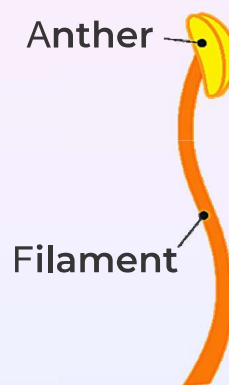
- the outermost whorl consisting of sepals
- Sepals are green and leaf like structure.
- Calyx protect the flower bud before it opens.

2 Corolla

- The second whorl, inner to calyx, consisting of petals.
- Petals are generally large, coloured and showy.
- Corolla attract insects for pollination.

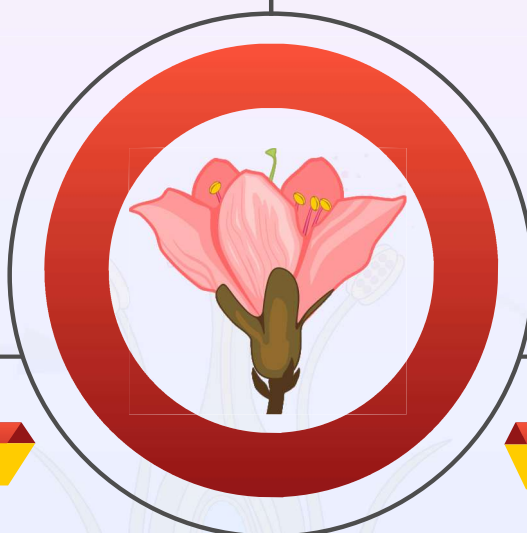
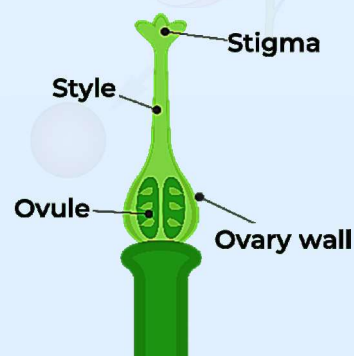
Androecium 3

- The third whorl, inner to corolla consisting of male reproductive parts called stamens.
- Each stamen has two parts filament and anther.
- Anther is bilobed structure present at the tip of filament.



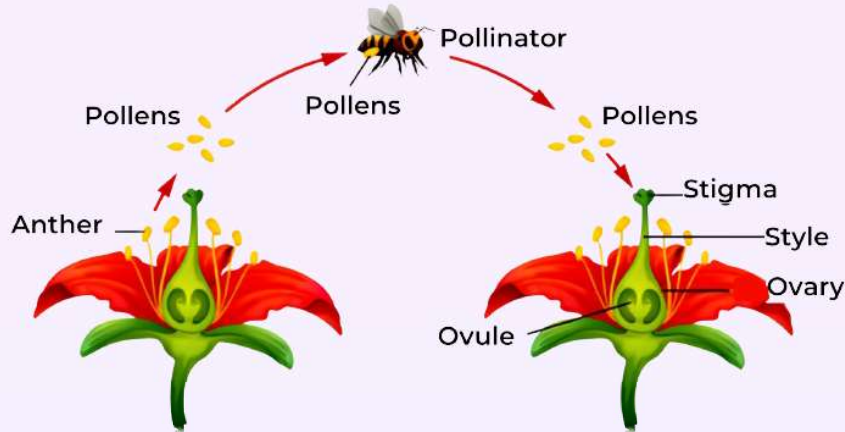
Gynoecium 4

- The fourth and innermost whorl consisting of carpels.
- Carpel is present in the centre of flower.
- Each carpel has three parts that is Ovary, Style and Stigma.
- Ovary is a swollen basal part of carpel that contains one or several ovules.



Pollination

► Process in which pollen grains are transferred from the anther to the stigma.



Self-pollination :

The transfer of pollen grains from an anther to the stigma of the same plant.

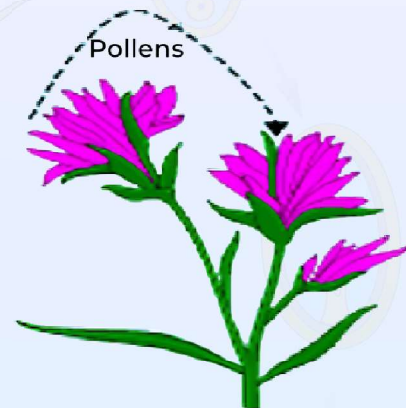
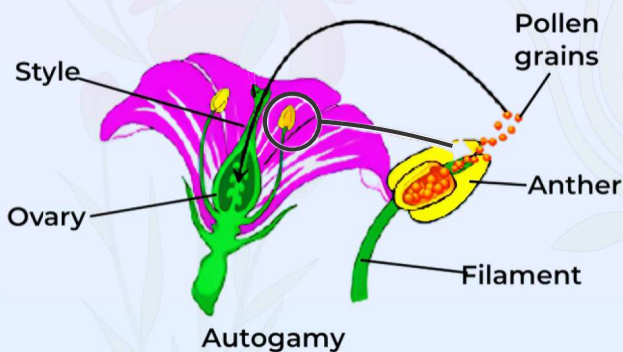
Autogamy :

If it is in the same flower.

e.g. Pea

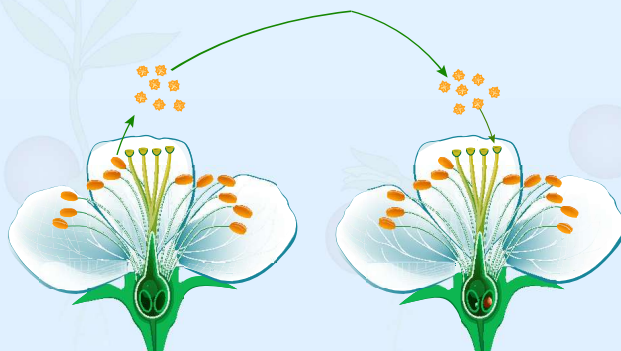
Geitonogamy :

If it is between flowers of the same plant., *e.g. Oxalis*

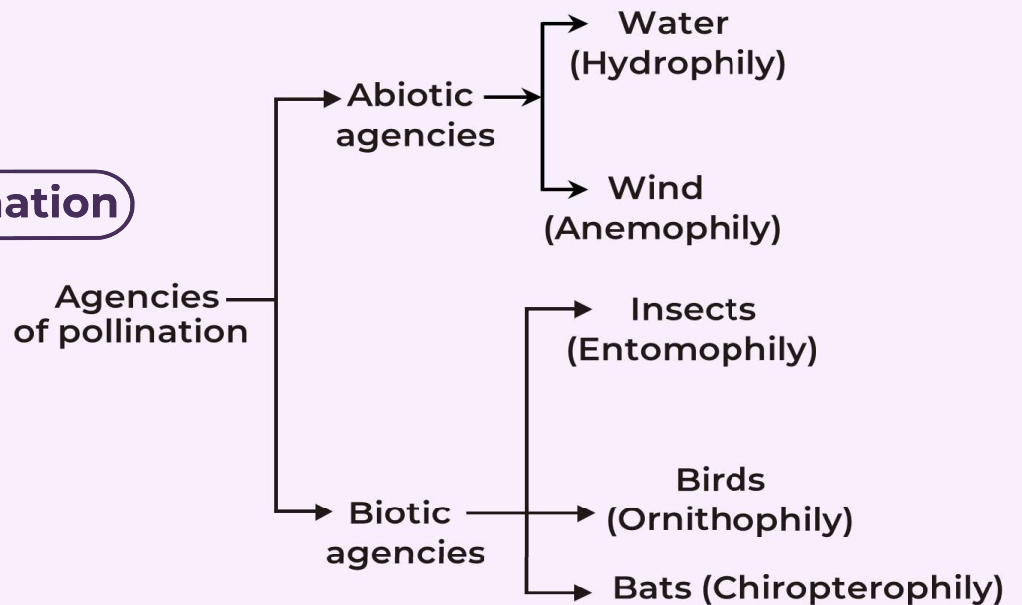


Cross pollination :

The transfer of pollen grains from anther to the stigma of different plants of the same species is called xenogamy *e.g. Mango*.

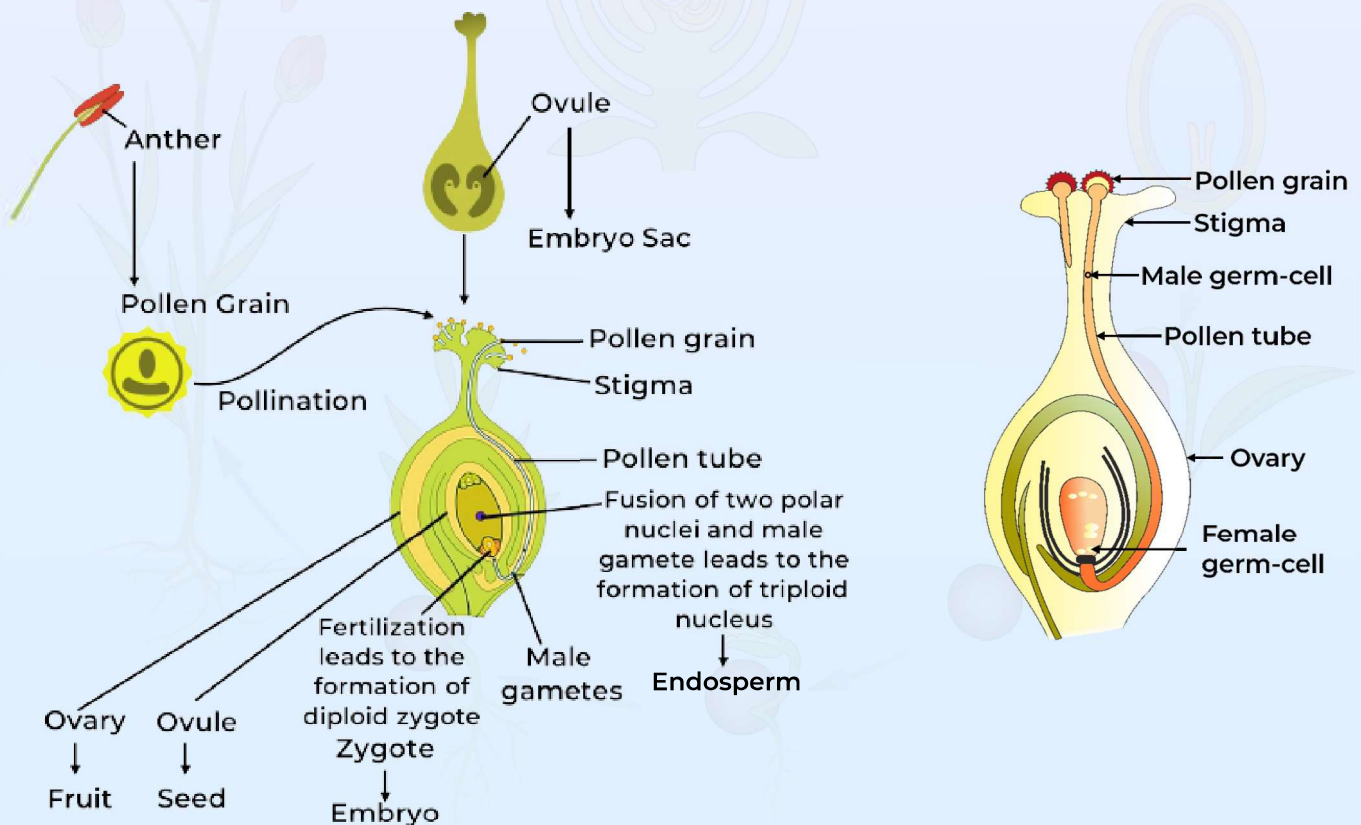


Agencies of pollination



Fertilization in Plant

- ▶ Fertilization is the process of fusion of the male and female gametes to form a diploid zygote which takes place in the embryo sac present in the ovule.
- ▶ After pollination, pollen grains germinate on the stigma by producing pollen tube.
- ▶ It then penetrates the stigma and passes through the style.
- ▶ The nucleus in the pollen tube divides into two male gametes/germ cells.
- ▶ Pollen tube enters the ovule through a narrow pore called micropyle.
- ▶ It releases two male gametes in embryo sac.



- ▶ One male gamete fuses with egg cell and second male gamete fuses with the two polar nuclei.

- ▶ One male gamete (n) + Egg cell (n) $\xrightarrow{\text{Syngamy}}$ Zygote (2n).

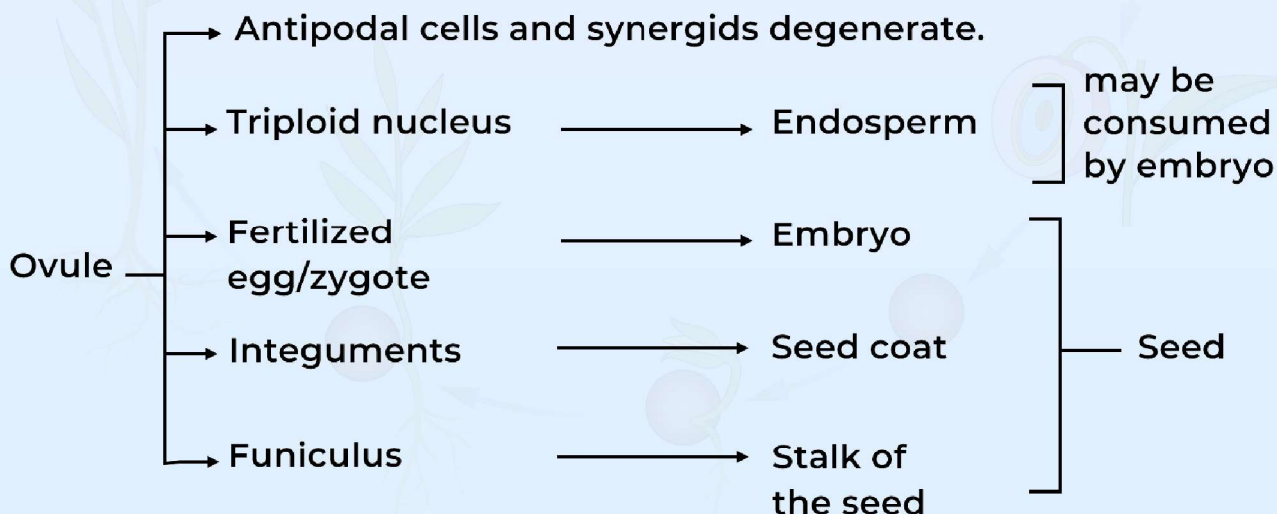
Second male gamete (n) + Two polar nuclei (n+n) $\xrightarrow{\text{Triple fusion}}$ Triploid nucleus
 Syngamy + Triple fusion = Double fertilization. (Primary Endosperm Nucleus) (3n)

Differences between pollination and fertilization

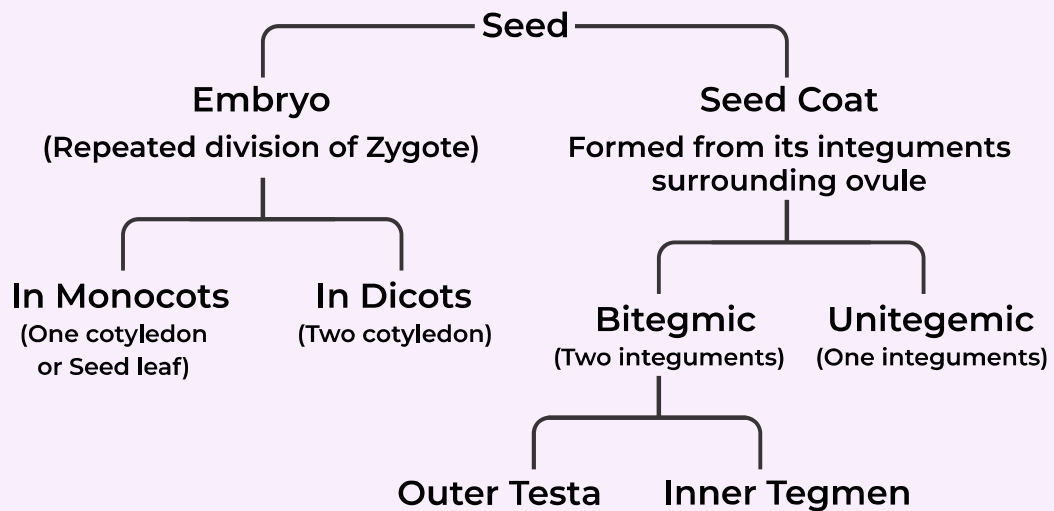
Pollination	Fertilization
Transfer of pollen grains from another to stigma.	Fusion of male and female gametes.
It does not ensure formation of zygote.	It ensures formation of zygote and further development.
It does not initiate fruit formation.	After fertilization ovary develops into fruits.
There are many agents of pollination.	Fertilization is always same in all plants.

Post fertilization changes in the flower

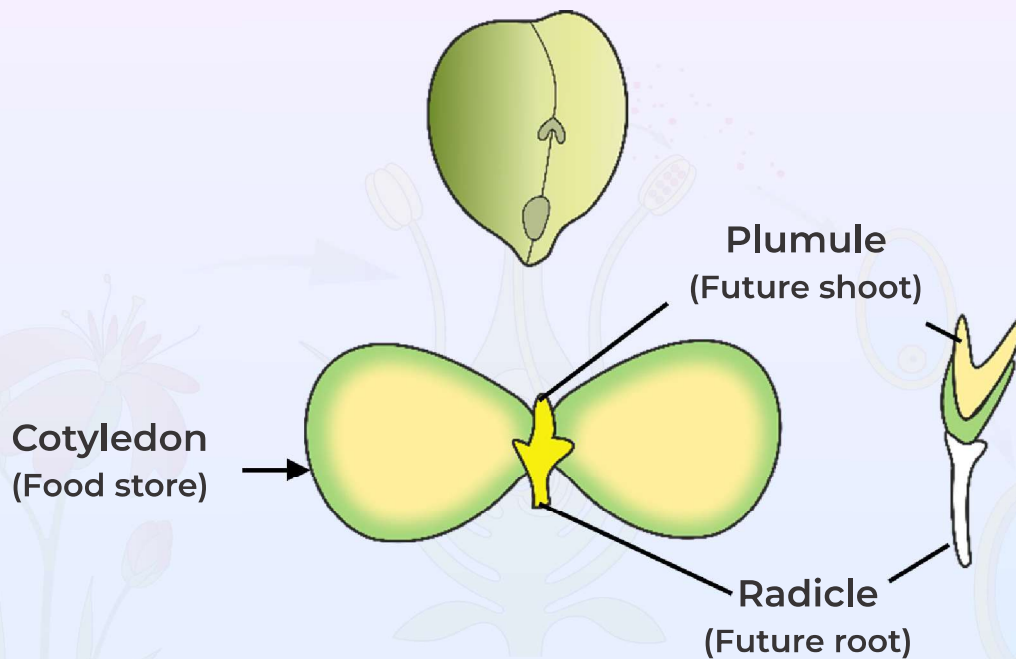
- ▶ Ovary develops into fruit and Ovule grows into seed.
- ▶ **Germination** : The seed contains the future plant or embryo which develops into a seedling under appropriate conditions.



Seed



Endosperm : Store of nutrients for the embryo.



Human reproductive system

Puberty

The age at which the gametes and sex hormones are produced and the boy and girl become sexually mature.

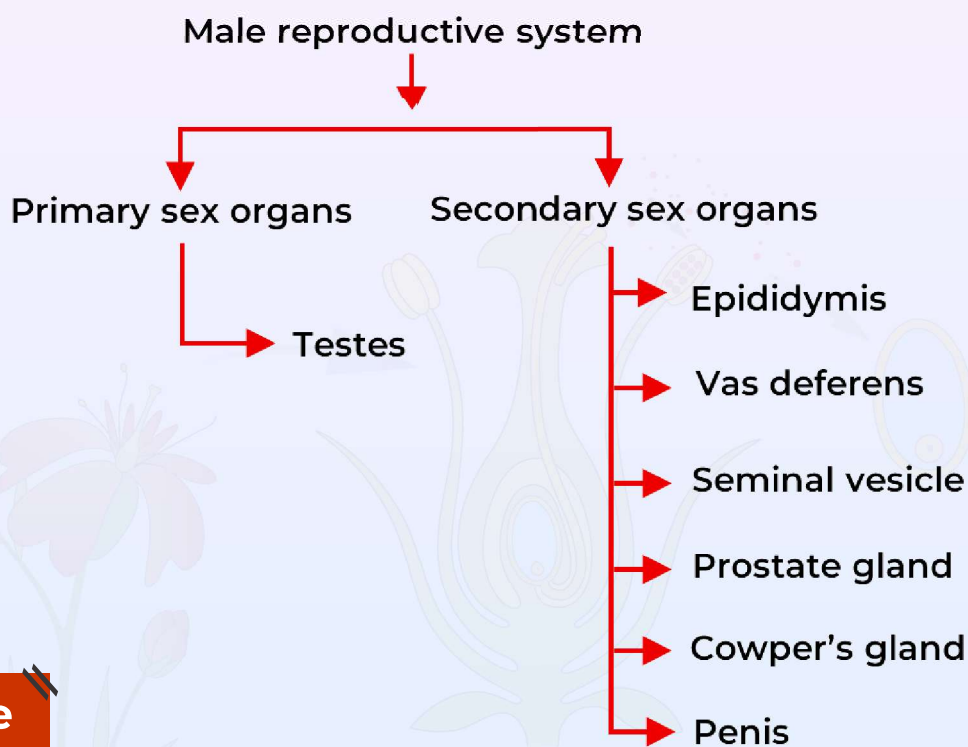
Secondary sexual characters

Physical or behavioral traits of an organism which are indicative of its biological sex.

Human male reproductive system

Secondary Sexual Characters in Male

- ▶ Widening of shoulders.
- ▶ Deepening of voice.
- ▶ Appearance of beard and moustaches.
- ▶ Growth of sex organs (testes and penis).



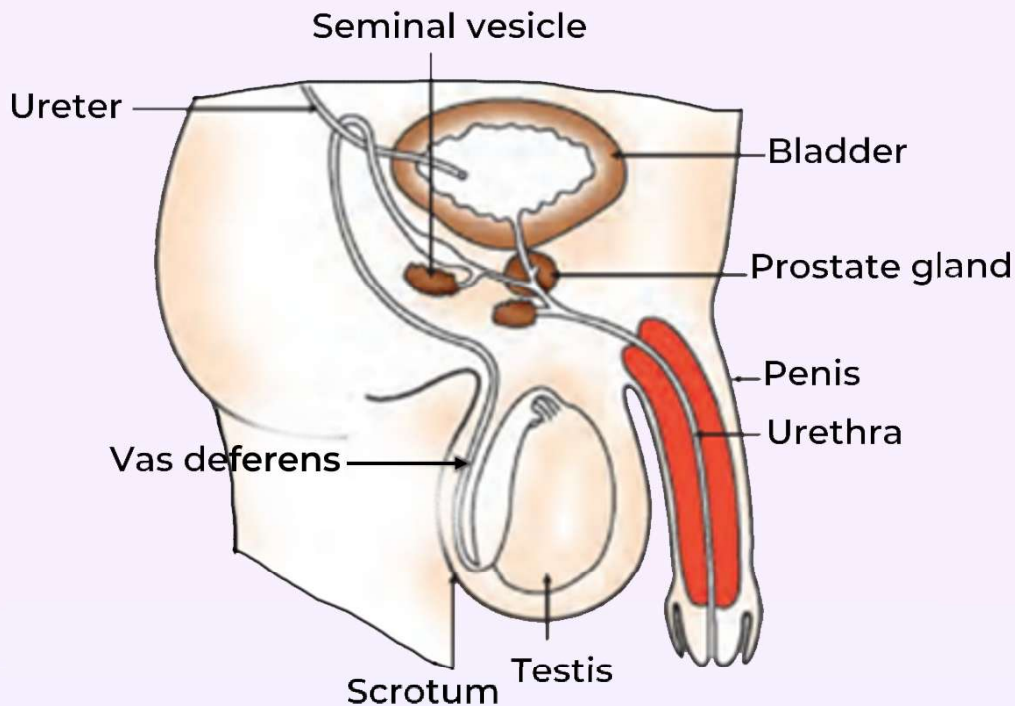
Note

Primary sex organs produce gametes while secondary sex organs are concerned with the conduction of gametes.

- ▶ The male reproductive system consists of portions which produce the germ cells and sex hormones and other portions that deliver the germ-cells to the site of fertilisation.

Note

Male gametes are called sperms in animals and pollen in plants while in all the organisms female gametes are called ova.



- ▶ The abdominal cavity in scrotum because sperm formation requires a lower temperature [$1-3^{\circ}\text{C}$] than the normal body temperature.
- ▶ Testes are the primary sex organs which produce the germ cells or sperms. They also secrete male sex hormone testosterone into the blood that brings development of secondary sexual characters in boys at time of puberty.
- ▶ Seminal vesicles adding a fluid medium to sperms and provides nutrition for sperms.
- ▶ Prostate gland adds fluid for their motility, maintaining pH in female reproductive tract.

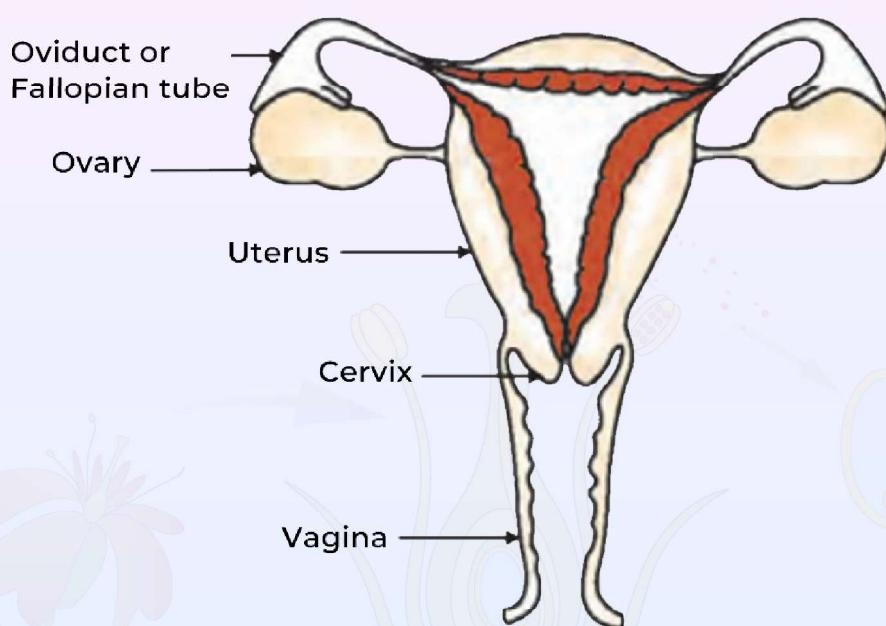
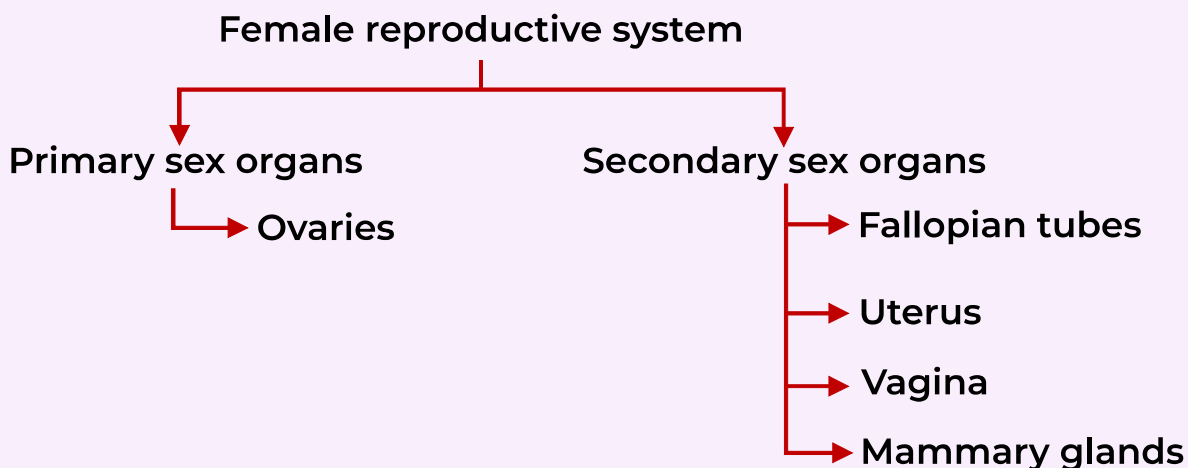
Structure of sperm



Female reproductive system

Secondary Sexual Characters in Female

- ▶ Widening of pelvis and hips. High pitch voice. Initiation of menstrual cycle.
- ▶ Growth of mammary glands (breasts). Maturation of secondary sex organs like fallopian tubes, uterus.



Ovaries

- ▶ Primary sex organs of the female
- ▶ The ovaries have both exocrine function that is production of ova and endocrine role that is secretion of female sex hormone, estrogen and progesterone.
- ▶ When a girl child is born, the ovaries already contain thousands of immature eggs and mature only on reaching puberty.
- ▶ One egg producing every month by one of the ovaries.

Fallopian tube (oviducts)

- ▶ Conveys the egg from the ovary to the uterus.
- ▶ Fertilization takes place here.

Uterus

- ▶ A large, highly elastic sac specialized for the development of the embryo.

Vagina

- ▶ Adapted for receiving the semen during copulation, allowing menstrual flow and serving as birth canal during parturition.

Embryo development and nourishment

- ▶ Implantation of zygote (fertilized egg) takes place in the inner lining of the uterus (endometrium).
 - The lining thickens and is richly supplied with blood to nourish the growing embryo.
 - The embryo gets nutrition from the mother's blood with the help of a special tissue called placenta.
 - The developing embryo will also generate waste substances which can be removed by transferring them into the mother's blood through the placenta.
 - The child is born as a result of rhythmic contractions of the muscles in the uterus, called labour pain.

Advantages of sexual reproduction

- ▶ More genetic variations within a species. Genetic variations can lead to evolutionary advancement.
- ▶ More variations assist with survival. It increases the chance that at least some offspring of a parent survive.

Note

Fertilization

Internal Fertilization

(Occurs inside the body of female)

E.g. Reptiles, Birds and Mammals

External Fertilization

(Occurs outside the body of female)

E.g. Invertebrates, Fish and Amphibians

Note

Hermaphrodite - The animals having both male and female reproductive organs are called hermaphrodite animals. e.g. Earthworms.

Reproductive Health

There are many infectious diseases which spread by sexual contact, called Sexually Transmitted Diseases (STDs) e.g. AIDS, Hepatitis.

Name of STDs	Causal Organism	Symptoms
AIDS (Acquired Immuno Deficiency Syndrome)	HIV (Human Immuno Deficiency Virus)	Destroy the immune system of body. Persistent cough and fever. Body attacked by other diseases like pneumonia, T.B. and certain cancers.
Syphilis	<i>Treponema pallidum</i> (a bacterium)	Causes sores and lesions in the genital tract. Burning sensation on urination.
Gonorrhoea	<i>Neisseria gonorrhoeae</i> (a bacterium)	Infects mucous membranes of the urinogenital tract. Genital discharge, painful urination.
Trichomoniasis	<i>Trichomonas vaginalis</i> (a protozoan)	Vaginal irritation, itching and discharge.
Genital warts	<i>Human papilloma virus</i>	Causes, Vaginal discharge, itching, bleeding, burning.

Methods of contraception :

1. Planned control of population :

- (i) By educating people about the advantages of small family
- (ii) Raising the age of marriage can help in reducing population growth.
- (iii) By family planning.

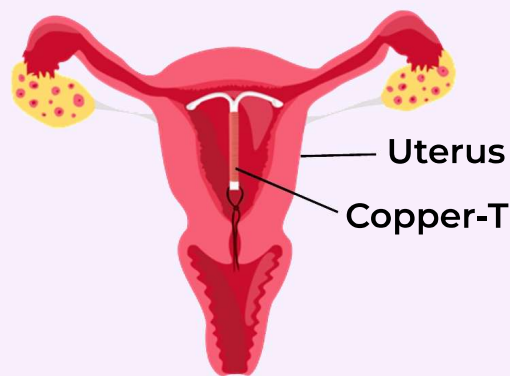
2. Natural method :

Intercourse is safe for a week before and week after menstruation.

3. Mechanical methods :

- (i) Use of condoms
- (ii) Use of diaphragms or cervical caps fitted in vagina of female.

- (iii) Use of IUCD i.e., Intra Uterine Contraceptive Devices like copper T.

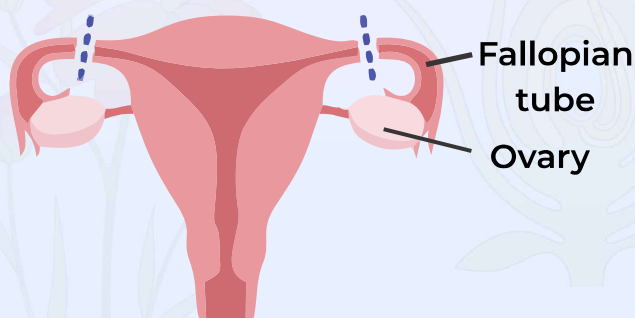


4. Chemical methods :

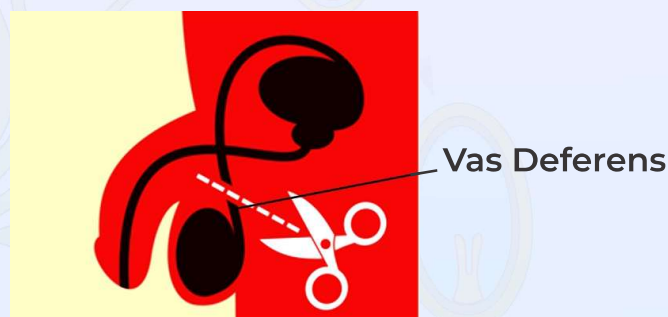
- (i) Use of some chemicals which are spermicidal may be in form of tablets, jellies, paste and creams introduced in the vagina before coital activity.
- (ii) Use of oral contraceptive (OC) pills.

5. Surgical methods :

- (i) Tubectomy involves cutting of fallopian tubes in females.
- (ii) Vasectomy involves cutting of vas deferens of each side in males.
- (iii) Surgical removal of ovaries is known as ovariectomy and removal of testes is known as castration.
- (iv) MTP is another surgical method is MTP i.e. Medical Termination of Pregnancy or abortion.
- (v) Other method is tubal ligation in which fallopian tubes are blocked by an instrument called laproscope.



Tubectomy in Females



Vasectomy in males

Note

- In tubal ligation, the fallopian tubes are blocked but eggs continue to be produced because the ovaries are intact. Eggs fail to pass into the uterus and sperms fail to reach the eggs for fertilization.
- Amniocentesis is a prenatal diagnostic technique to determine the genetic disorders in the foetus. Amniocentesis is being misused to kill the normal female foetuses as it can help to detect the sex of foetus also. Determination of sex by amniocentesis has been banned.