CHAPTER 8

How do Organisms Reproduce?

Reproduction:

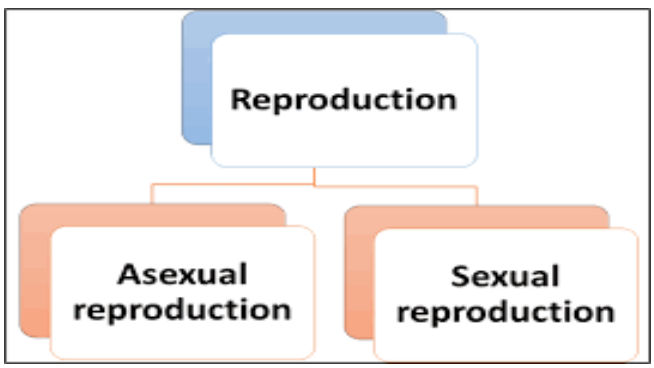
- Reproduction is an integral feature of all living beings.
- The process by which a living being produces its own like is called reproduction.

Importance of Reproduction:

- This is the only way for a living being to continue its lineage.
- Reproduction helps in maintaining a proper balance among various biotic constituents of the ecosystem.
- Reproduction also facilitates evolution because variations come through reproduction; over several generations.

The Importance of Variation:

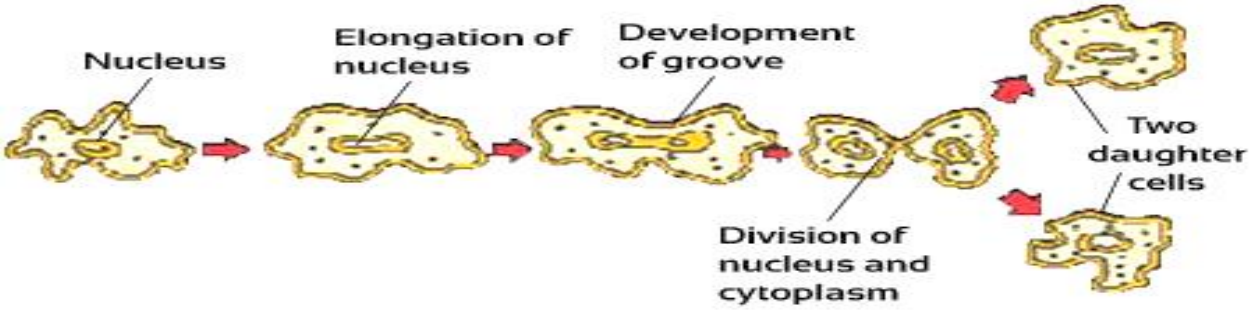
- Mostly variations are found in sexual mode of reproduction but in asexual reproduction the main contributing factors for variations are environmental factors other than genetic factors.
- Reproduction is linked to the stability of populations of species.
- However, niches can change due to variations in temperature, water level etc.
- If the niche were drastically altered, the population could be wiped out.
- However, if some variations were to be present in a few individuals in these populations, there would be some chance for them to survive.
- Variation is thus useful for the survival of species over time.



Reproduction in Simple Organisms:

Binary Fission:

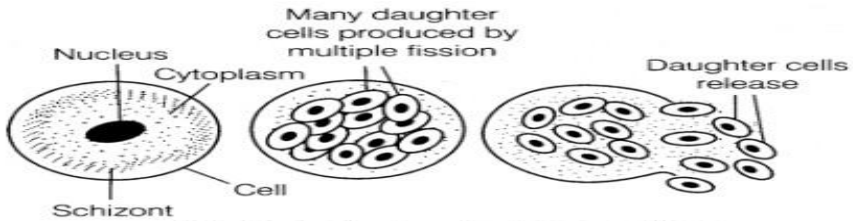
- Most of the unicellular animals prefer this method for reproduction.
- These organisms reproduce by **binary fission**; especially whenadequate amount of food and moisture are available.
- Binary fission is somewhat similar to **mitosis**.
- The mother cell divides into two daughter cells; and each daughter cell begins its life like a new individual. The parent generation ceases to exist, after binary fission.
- Amoeba is a very good example of the organism which reproduces by binary fission.



Binary Fission in Amoeba

Multiple Fission:

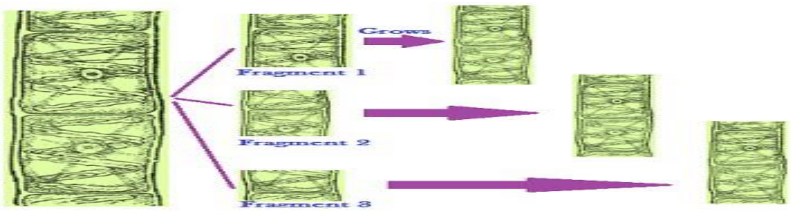
- When conditions become unfavorable, i.e. food, moisture, proper temperature, etc. are not available; this is the preferred mode of reproduction by unicellular organisms.
- The organism develops a thick coating around itself. This is called **cyst.**
- The cyst helps the organism to tide over the bad phase.
- All metabolic activities stop in the organism, after cyst formation.
- When favorable conditions return, the cyst dissolves or breaks down;releasing the daughter nuclei.
- The daughter nuclei; in turn; grow into new individuals.
- Plasmodium and Entamoeba undergo cyst stage, when they are not inthe body of their prime host, i.e., humans.



Multiple fission in *Plasmodium*

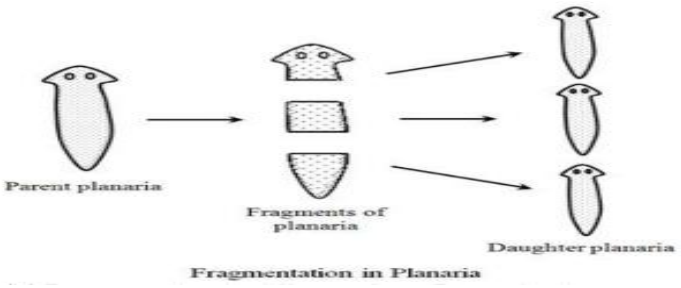
Fragmentation:

- In multi-cellular organisms with relatively simple body organization, simple reproductive methods can still work.
- Spirogyra, for example, simply breaks up into smaller pieces upon maturation. These pieces or fragments grow into new individuals.
- However, this is not true for all multi-cellular organisms because many multi-cellular organisms are not simply a random collection of cells.
- Specialized cells are organized as tissues, and tissues are organized into organs, which then have to be placed at definite positions in the body.
- In such a carefully organized situation, cell-by-cell division would be impractical.



REGENERATION

If the individual is somehow cut or broken up into many pieces, many of these pieces grow into separate individuals. For example, simple animals like Hydra and Planaria can be cut into any number of pieces and each piece grows into a complete organism. This is known as regeneration (see the below figures). Regeneration is carried out by specialized cells. These cells proliferate and make large numbers of cells.

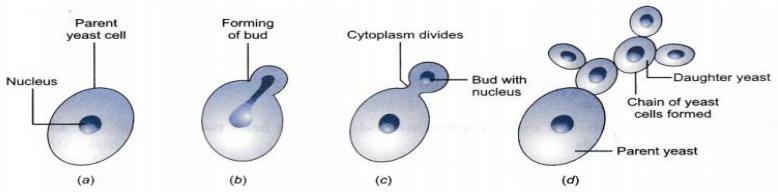


Fragmentation in Planaria

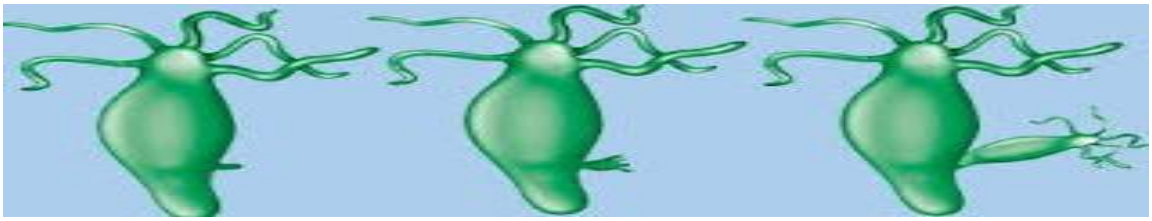
Budding: Yeast is an example of unicellular organism which reproduces by budding. Hydra is an example of multicellular organism which reproduces by this method.

Budding in Yeast:

- A small bud grows at any end of the yeast cell.
- Nucleus gets elongated and a part of it protrudes into the bud.
- The nucleus then divides into two nuclei.
- One of the nuclei goes into the bud.
- The bud grows to certain extent and gets detached from the mothercell.



Budding in Hydra: A bud grows anywhere on the main body of hydra. The bud grows to a certain size and gets detached from the motherhydra. This develops further to grow into a new individual.



SPORE FORMATION

Rhizopus produces hundreds of microscopic reproductive units called spores. When the spore case (also called sporangium) bursts, the spores spreads into air. These air-borne spores land on food or soil, under favorable conditions like damp and warm conditions, they germinate and produce new individuals. Most of the fungi like Rhizopus, Mucor etc., Bacteria and non- flowering plants such as ferns and mosses reproduce by the method of spore formation.

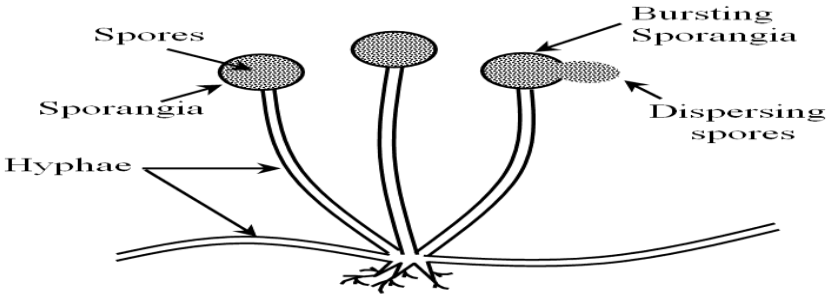


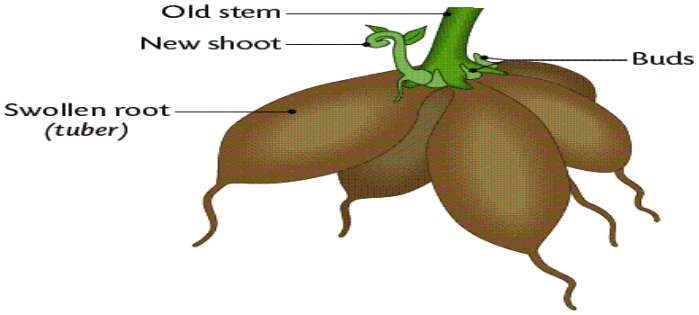
Fig. 5 Spore formation in Rhizopus

Vegetative propagation

I t is the ability of plants to reproduce by bringing forth new plants from existing vegetative structures without sexual reproduction. Some examples of vegetative propagation are given below.

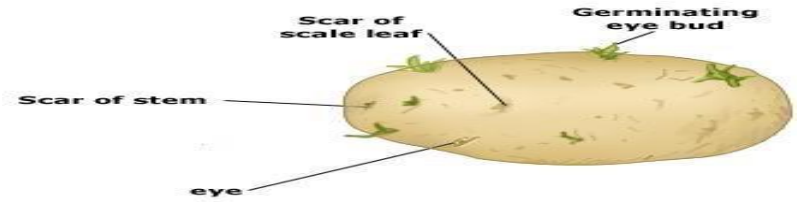
a. By roots-

Some modified tuberous **roots** can be **propagated** vegetatively, when planted in soil. The buds present on the **roots** grow as leafy shoots called slips above ground and adventitious **roots** at their bases. Each slip gives rise to a new plant.



b. By stem-

vegetative methods (cloning). Potato tubers have nodes or eyes from which the new growth begins. The new stems growing from each eye are called sprouts which giver rise to the new plant. Vegetative seed can be either a whole tuber or a cut tuber.



c. by leaves-

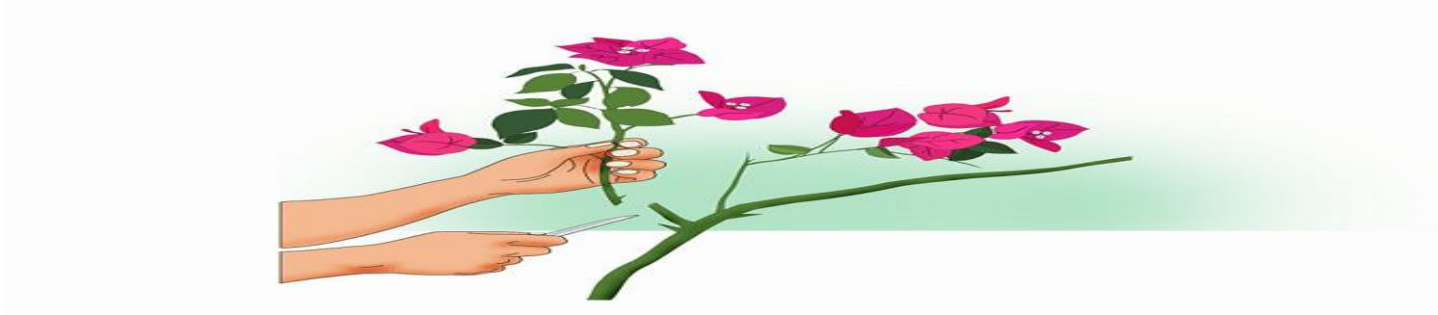
Reproduction in Bryophyllum occurs asexually through vegetative propagation by leaves. ... These buds can give rise to new plants with adventitious roots, shoots and small leaves. The new plants then detach from the leaves and develop into a mature plant after coming in contact with the soil.

Artificial Vegetative Propagation

a. Cutting
b. layering
c. Grafting

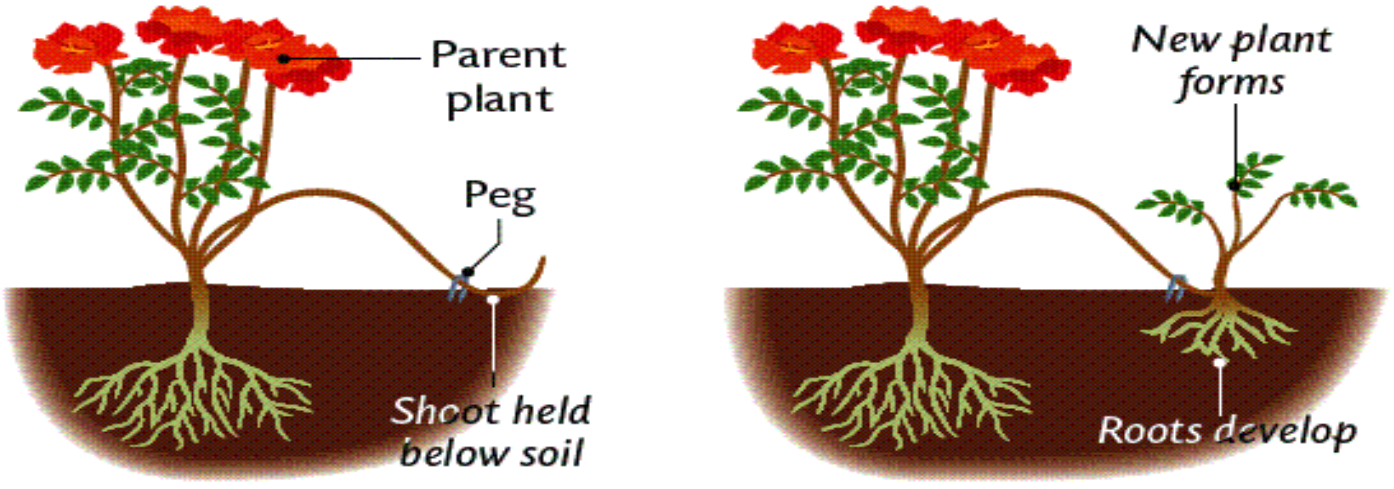
a. Cutting-

Vegetative Propagation by Stem Cutting. Stem-cutting is another common asexual propagation technique, suited well to herbs and house plants. ... It involves taking a section of stem from a parent plant and manipulating it to create a new plant.



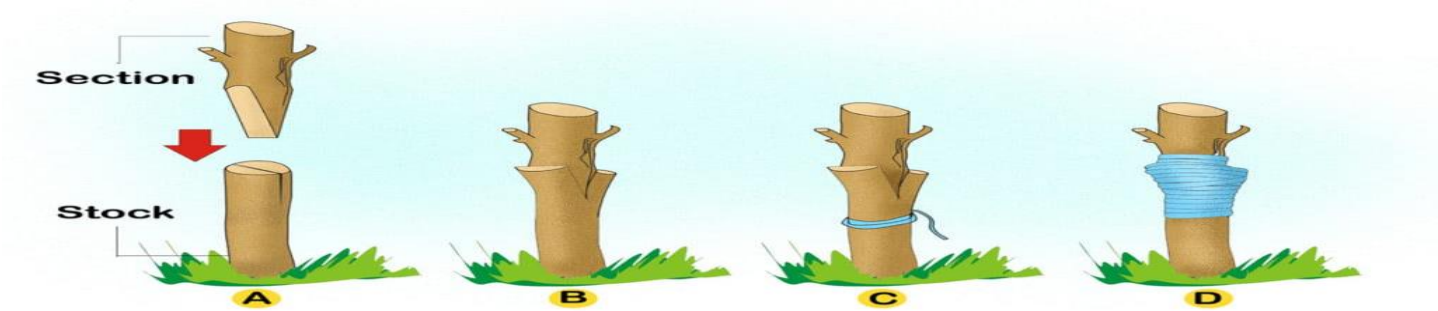
b. Layering-

It is a means of plant propagation in which a portion of an above-ground stem grows roots while still attached to the parent plant and then detaches as an independent plant. Layering has evolved as a common means of vegetative propagation of numerous species in natural environments.



c-Grafting

it is the act of placing a portion of one plant (bud or scion) into or on a stem, root, or branch of another (stock) in such a way that a union will be formed and the partners will continue to grow.



Tissue culture

Tissue culture involves the use of small pieces of plant tissue (explants) which are cultured in a nutrient medium under sterile conditions. Using the appropriate growing conditions for each explant type, plants can be induced to rapidly produce new shoots, and, with the addition of suitable hormones new roots.

CHAPTER 8

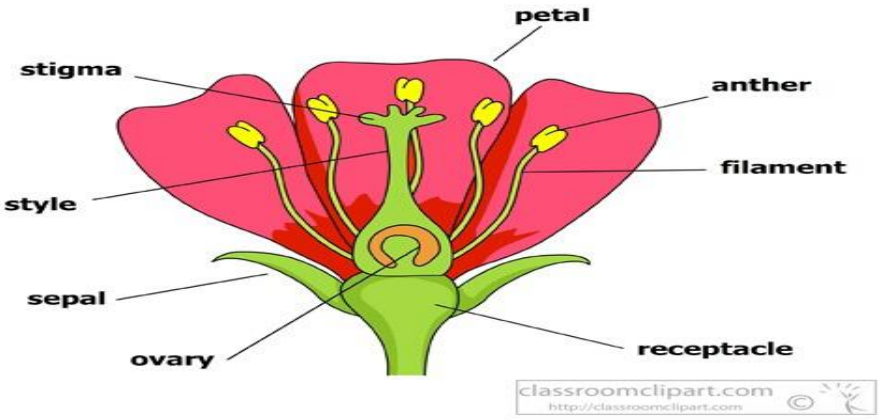
How do Organisms Reproduce?

Sexual Reproduction in Flowering Plants:

- Flower is the **reproductive organ** which bears special organs and plays the role of the reproductive system in plant.

Structure of a typical Flower:

- A typical flower is composed of four distinct whorls, viz. calyx, corolla, androecium and gynoecium.



Calyx:

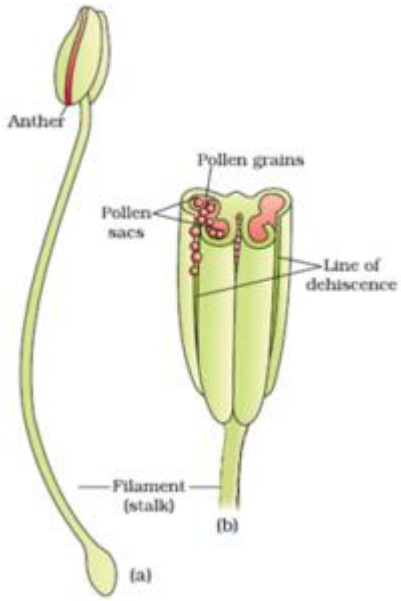
- The outermost whorl of the flower is called **calyx.**
- It is composed of green leaf-like structures; called **sepals.**

Corolla:

- The second whorl of the flower is called **corolla.**
- It is composed of colourful leaf-like structures; called **petals.**
- Petals are colourful so that insects and birds can be attracted; to assistthe flower in **pollination.**

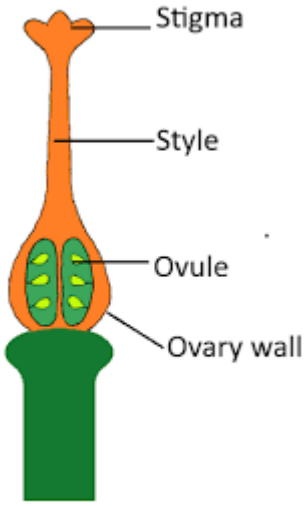
Androecium:

- This is the third whorl in the flower.
- It is composed of **stamens.**
- Stamen is made of a slender **stalk** and **anthers** on top.
- Anthers produce the **pollen-grains.**
- Pollen grains are the **male gametes.**



Gynoecium:

- This whorl is at the centre of the flower.
- It is composed of a swollen base; called **ovary.**
- A slender **style** stands upright on the ovary.
- It has a flat top; called **stigma.**
- **Ovules** are inside the ovary.



Gynoecium (Pistil)

CHAPTER 8

How do Organisms Reproduce?

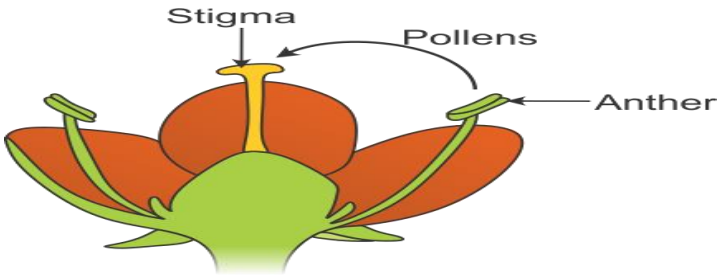
pollination:

- Transfer of pollen grains from the anther to the stigma is called pollination.
- Pollen grains are transferred mainly by wind, water and insects. They are called as pollinating agents. Pollination is the first and important event in the development of the fruit and seed.
- Pollination is followed by fertilization.

Types of pollination:

- Pollination is of two types. They are
- 1-Self pollination
- 2- Cross pollination

Self-pollination:
Self-pollination is also known as autogamy. The transfer of pollen grains from the anther of a flower to the stigma of the same flower or another flower of the same plant is known as self-pollination.



Cross pollination:

- The transfer of pollen grains of a flower to the stigma of another flower of a different plant of the same species is called cross pollination or allogamy.

Agents of pollination:

- Pollination is affected by many agents like wind, water, insects etc.
- On the basis of the agents that bring about pollination, the mode of pollination is divided into abiotic and biotic. The latter type is used by majority of plants.

Abiotic agents

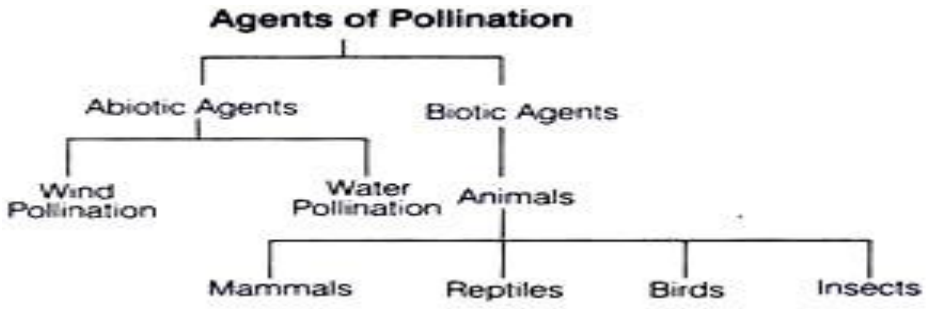
1. Anemophily - pollination by Wind

2. Hydrophily - pollination by Water

Biotic agents

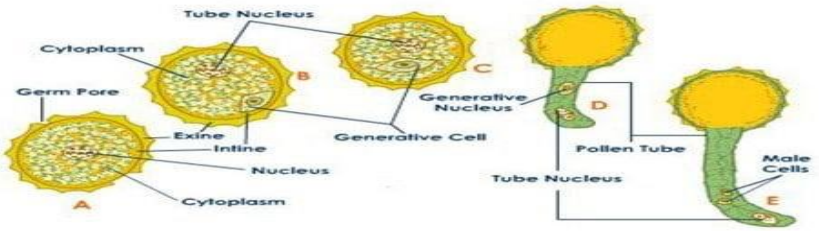
3. Zoophily

Zoophily refers to pollination through animals and pollination through insects is called Entomophily.



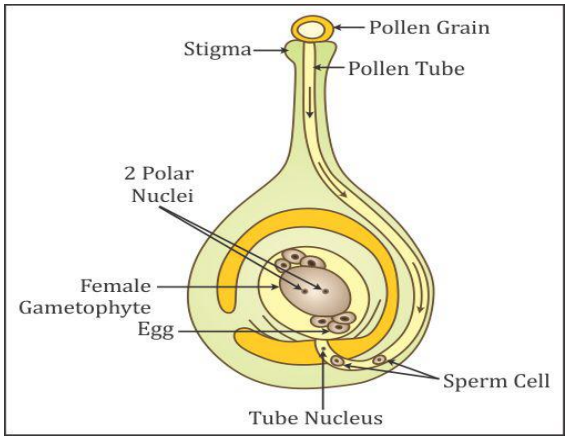
Fertilization:

- The fusion of male and female gamete is called fertilisation.
- If pollen grain falls on a suitable stigma, it absorbs water and nutrients, grows a pollen tube
- The pollen grain contains two male gametes
- The pollen tube enters into the embryo sac through micropyle.
- At this time, the pollen tube bursts open, gametes released from the pollen tube and enter into the embryo sac.
- One of the gametes fuses with the egg, and the other fuses with the secondary nucleus.
- The fusion of a male gamete with egg is known as fertilization.
- The fertilized egg is known as zygote which develops into embryo.



Double fertilization:

- The other male gamete fuses with the secondary nucleus.
- The secondary nucleus is diploid in nature. The fusion of this nucleus with the second male gamete is known as triple fusion.
- The triple fusion nucleus is called endosperm nucleus because it develops into endosperm. Endosperm is a nutritive tissue meant for the development of the embryo.
- The process of fusion of a male gamete with egg and the other gamete with secondary nucleus is known as double fertilization.

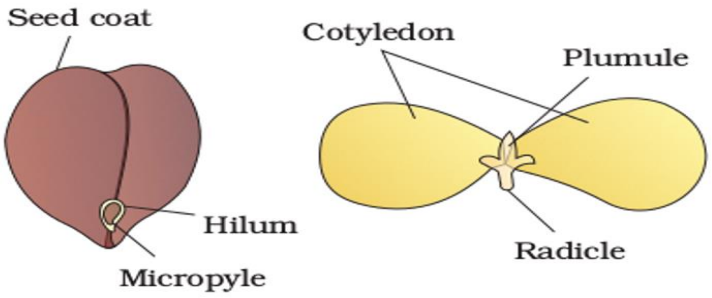


Post fertilization events:

- The calyx and corolla wither and fall off and so do the stamens.
- The ovary turns into the **fruit.**
- The ovule develops into seed**.**
- Once the seed becomes mature, fruit dries up so that dispersal of seeds cantake place.

Structure of Seed:

- A seed contains an embryo, some reserve food and is enclosed by a protective covering; called **seed coat**.
- The reserve food is stored in the **cotyledons.**
- The embryo has two pointed parts. The upper part is called **plumule** which gives rise to the **shoot system.** The lower part is called **radicle** which gives rise to the **root system.**
- Cotyledons supply food when the embryo needs it during **germination.**
- Seed germination is the process by which the embryo in the seed kick-starts anew life



Structure of dicotyledonous seed

CHAPTER 8

How do Organisms Reproduce?

Puberty:

- Human beings are complex animals and hence there is a distinct phase in their life cycle which marks the onset and attainment of sexual maturity.
- This period is called puberty. It usually starts at around 10 – 11 years of age in girls and at around 12 – 13 years of age in boys.
- It usually ends at around 18th year of age in girls and at around 19th year of age in boys. Since the years during puberty end in 'teens'; hence this phase is also called teenage.

Changes in Boys during Puberty:

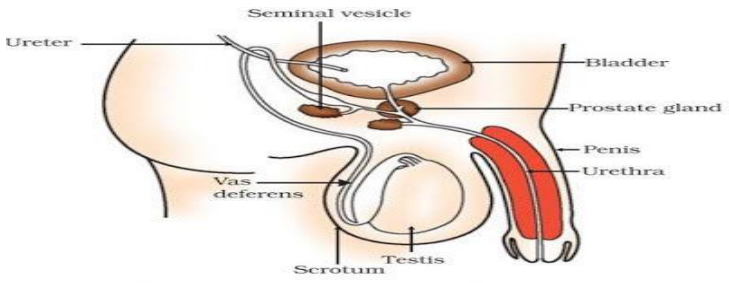
- The boys suddenly grow in height dramatically.
- Voice becomes deep and the Adam's apple becomes prominent.
- Shoulders become broad and body becomes muscular.
- Facial hairs begin to grow.
- Hairs also grow under the armpit and in the pubic region

Changes in Girls during Puberty:

- The voice becomes thin.
- Shoulders and hip become rounded.
- Breasts get enlarged.
- Hairs grow under the armpit and in the pubic region

Male Reproductive System:

- The male reproductive system in human beings is composed of followingparts:



Human–male reproductive system

a-Testis:

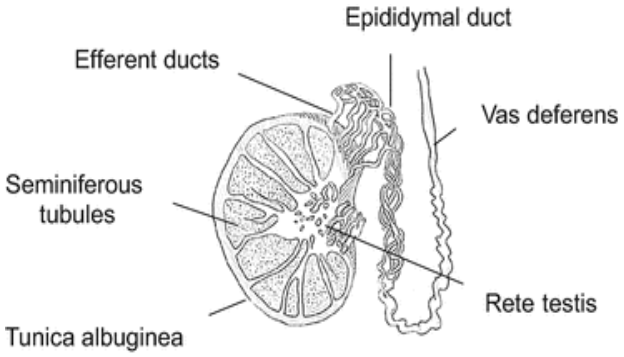
- There is a pair of **testes**; which lie in a skin pouch; called **scrotum.**
- Scrotum is suspended outside the body; below the abdominal cavity.
- This helps in maintaining the temperature of testes below the bodytemperature.
- This is necessary for optimum **sperm** production.
- **Sperms** are the **male gametes**.
- Apart from that, testis also produces **testosterone.**
- Testosterone is also called the male hormone, as it is responsible fordeveloping certain secondary sexual characters in boys.

b- epididymis:

- It is highly coiled structure found on the upper side of the testes.
- site of sperm maturation: about 10-14 days are required for the sperm to mature.
- store mature sperm: sperms may remain in storage for up to 4 weeks .After that they are expelled from the epididymis or reabsorbed.

c-Vas Deferens:

- Vas deferens is the tube which carries sperms to the seminal vesicle.



d-Seminal Vesicle:

- This is the place where sperms are stored.
- it provides alkaline substances which contains carbohydrate, proteins and hormones
- Carbohydrates provides the energy source for the sperms
- Protein helps in sperm coagulation.
- Alkaline nature of the fluid protects the sperm from acidic condition.

e – prostate gland

- It is present at the base of the urinary bladder which encircling the urethra
- It secretes thin, alkaline, milky substances which contributes to sperm motility and viability.

f- Cowper's glands

- It is located under the prostate gland
- It secretes the mucus which lubricates the end of the penis during sexual intercourse.

g-Penis:

- It is a muscular organ
- It carries urine.
- Transfers the sperm in to the female body.

Semen:

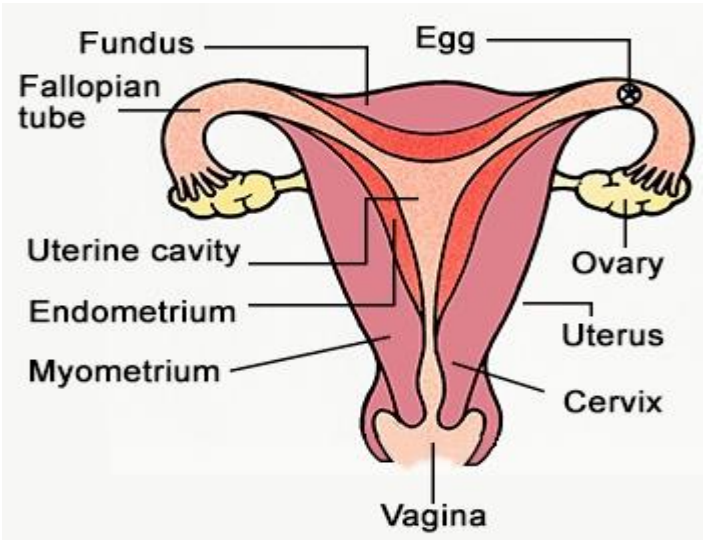
- Semen is a mixture of sperm and the secretions of seminal vesicles, prostate gland, and Cowper's gland
- It is a milky white fluid.
- A single ejaculation contains 2-3 ml semen.
- A single ejaculation contains 20,000,000 – 40,000,000 sperms.

CHAPTER 8

How do Organisms Reproduce?

Female Reproductive System: The female reproductive system in human beings is composed of followingparts:

- Uterus
- Fallopian tube
- Ovaries
- Vagina

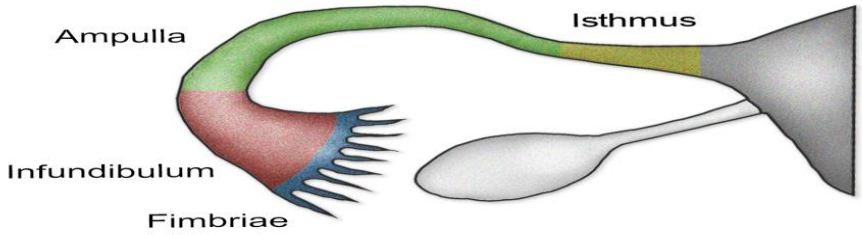


Uterus

- This is pear-shaped hollow muscular organ.
- Uterus is the place where the embryo gets implanted and develops into a newborn baby.
- The wall of the uterus provides safety and nutrition to the growing foetus.

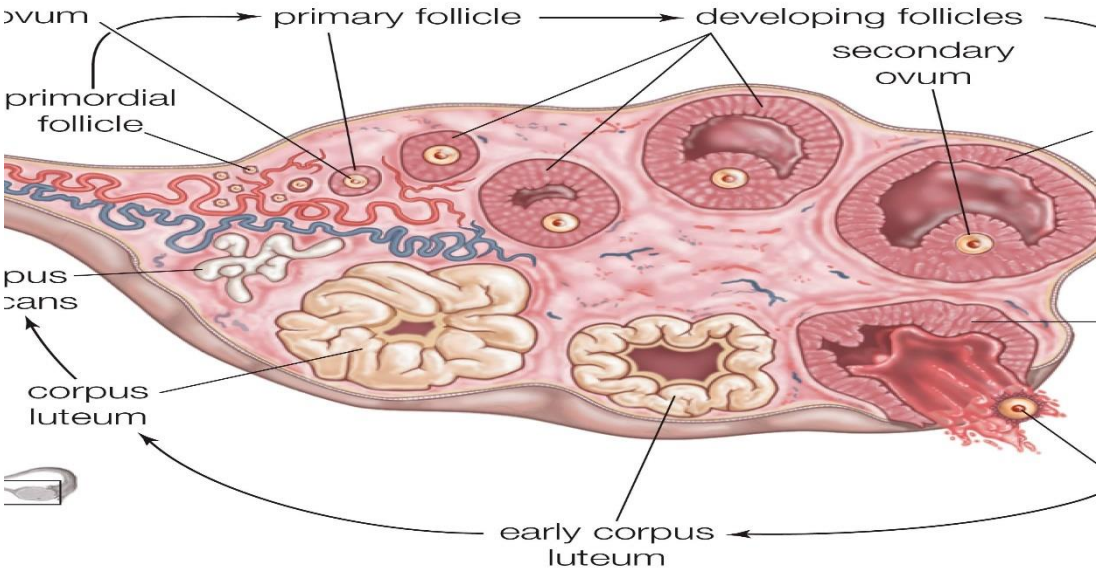
Fallopian tubes

- One fallopian tube comes out from each side at the top of the uterus.
- The fallopian tubes end in finger-like structures; called fimbriae.
- Fertilization happens in the fallopian tube.



Ovary

- There are two ovaries; one near each fallopian tube.
- Ovary produces the eggs or the female gametes.
- All the eggs are produces by the ovary when the female child is still in the womb.
- One egg matures in each ovulation cycle and is released from the ovary.
- The egg is caught by the fimbriae and transferred to the fallopian tube.

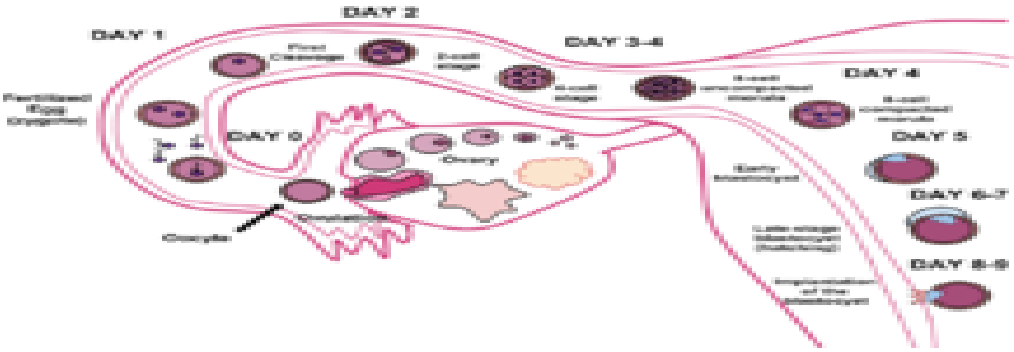


Vagina

- The cervix (mouth of the uterus) opens into the vagina.
- Vagina is a muscular tube-like organ; which serves as the passage for the sperms and also as the canal during the child birth.

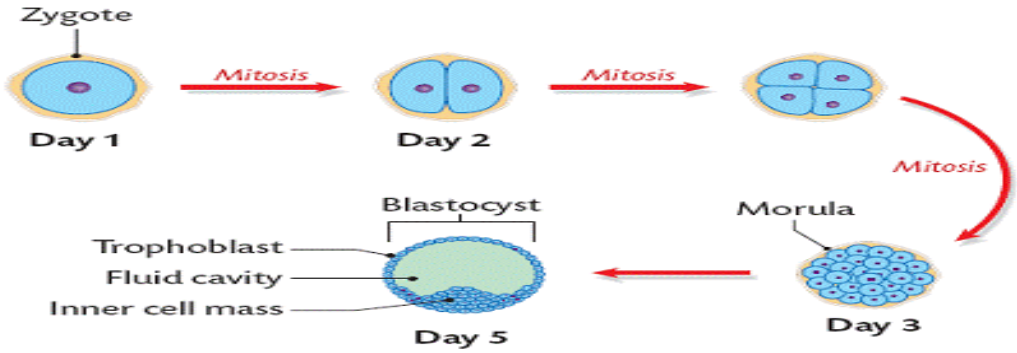
Fertilization:

- Fertilization happens when a sperm cell successfully meets an egg cell in the fallopian tube.
- Once fertilization takes place, this newly fertilized cell is called a zygote.
- From here, the zygote will move down the fallopian tube and into the uterus.



Process of Fertilization

- Fertilization is the most important part of sexual reproduction where the male gamete or the sperm penetrates the female gamete or the ovum to form a zygote.



- In humans, the sperm is motile and the ovum is non-motile, hence for fertilization to occur the two gametes must be brought together. This happens with insemination when a male releases sperm into the female's vaginal canal.

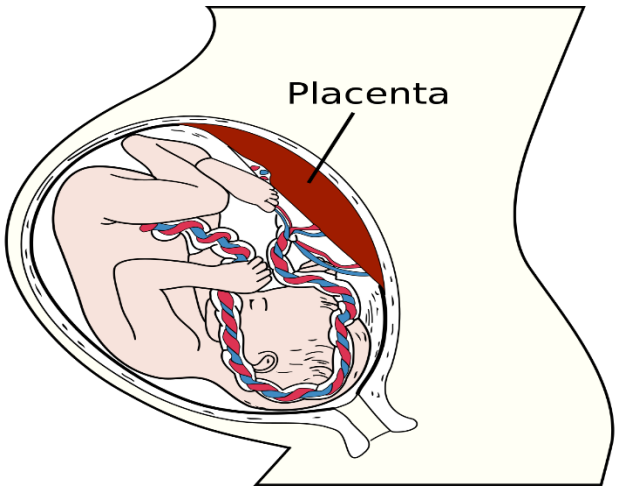
- Only the healthy and strong sperms are able to swim up and reach the oviducts while the rest die on the way.

- If there is an egg in the oviduct, the sperm penetrates it. The sperm and egg nucleus fuse to form a diploid zygote.

- After fertilization, the zygote divides to form a several-celled embryo which is implanted in the uterus and eventually develops into the foetus.

Implantation:

The zygote undergoes mitotic division and forms a blastocyst which in turn forms a pit in the endometrial wall and gets fixed to it in about 5-7 days after ovulation. This process is called implantation and results in pregnancy.



Placenta: A flattened circular organ in the uterus of pregnant eutherian mammals that nourishes and maintains foetus through the umbilical cord.

- It is composed of blood capillaries, villi, connecting tissue and endocrinal cells.
- It is formed by the union of endometrial tissue, chorion, and allantois which is the embryonic tissue.

Importance of the placenta in the human reproductive system

- Even though the foetus is connected to the mother, the foetus has a separate circulatory system from that of the mother. Due to this separate circulatory system, the foetus is protected from pathogens and the blood pressure variations of the mother.
- The placenta acts as a bridge connecting the two systems helping with the diffusion of nutrients, waste, and gases.

Gestation:

The process or period of development of the embryo inside the womb between conception and birth. It is approximately 280 days for humans.

Amnion:

- Amnion is the innermost foetal membrane or sac which develops around the embryo.

- It secretes the amniotic fluid and protects it from physical damage.

Parturition:

- The process by which a full-term foetus emerges from the uterus due to contraction through the birth canal is called parturition or child birth.

What happens when egg is not fertilized

- When the egg is not fertilized, it is shredded off from the body and menstrual cycle takes place.
- Ovary releases one egg every month. At the same time, the uterus also prepares itself to receive a fertilized egg.
- The endometrium lining becomes thick and spongy for carrying embryo

CHAPTER 8

How do Organisms Reproduce?

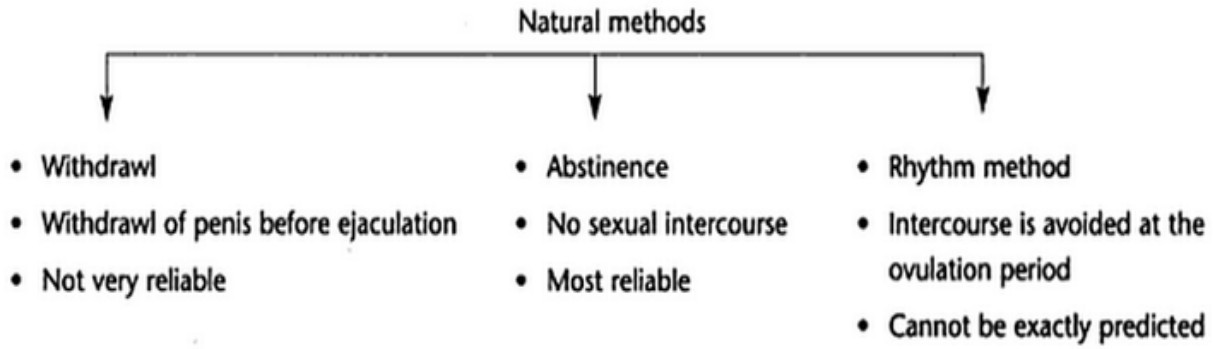
Reproductive Health:

- Reproductive health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity, in all matters relating to the reproductive system and to its functions and processes

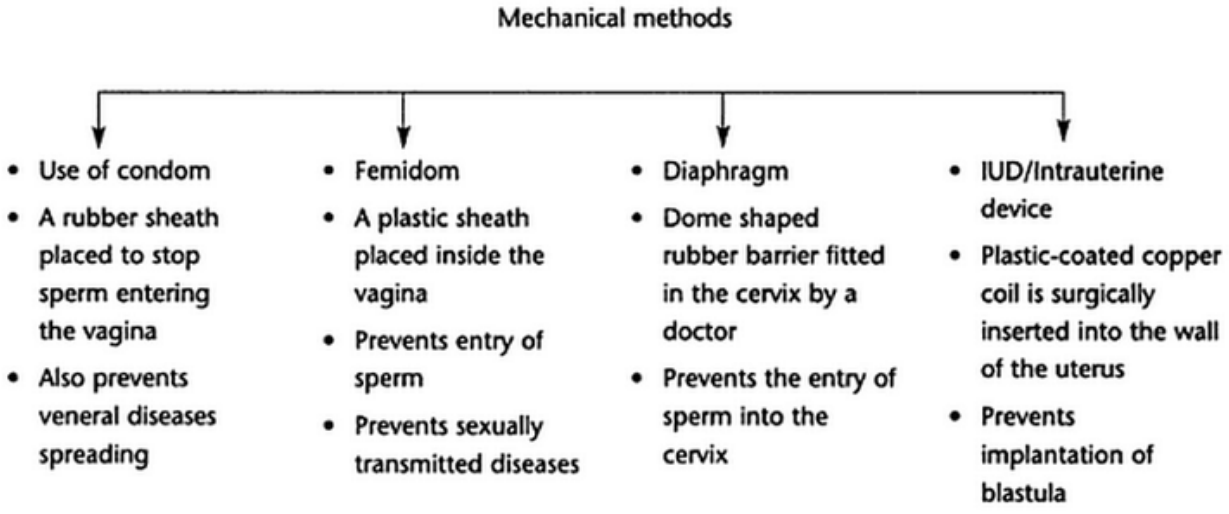
Contraception:

Contraception (birth control) prevents pregnancy by interfering with the normal process of ovulation, fertilization, and implantation. There are different kinds of birth control that act at different points in the process

1- Natural method-



2- Barrier methods-



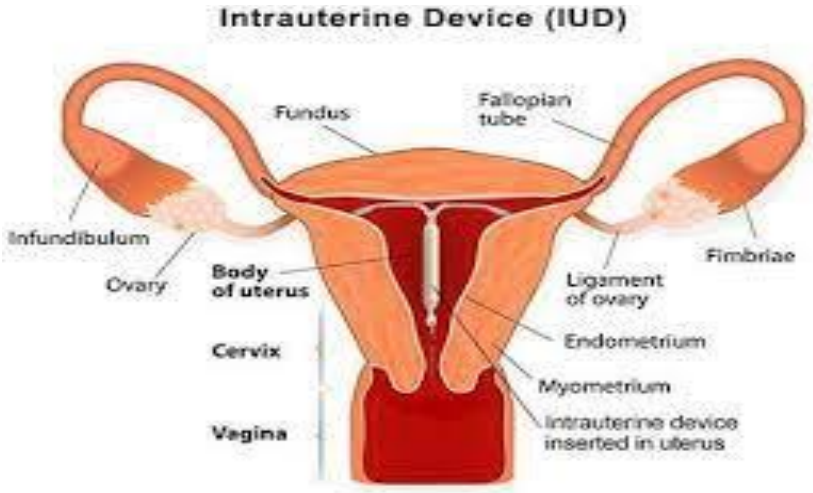
3- Chemical methods-

Chemical methods

- Contraception pill
- Contains progesterone and oestrogen which prevent ovulation
- Progesterone only prevents implantation of blastula

- Spermicidal
- Kills sperm in the vagina
- Should only be used with condom/diaphragm

4- IUCD-

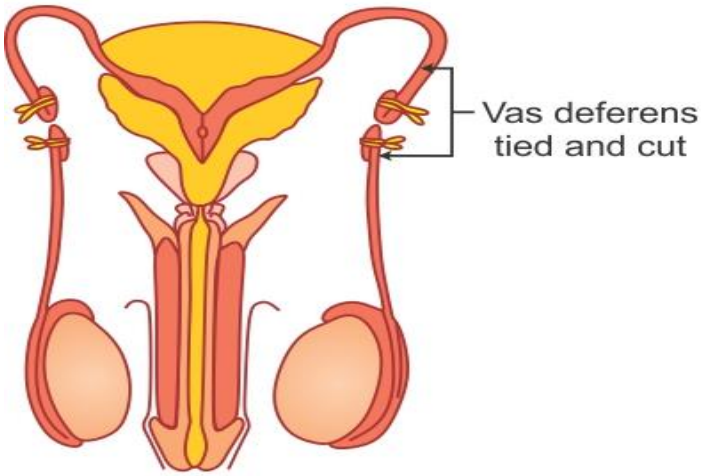


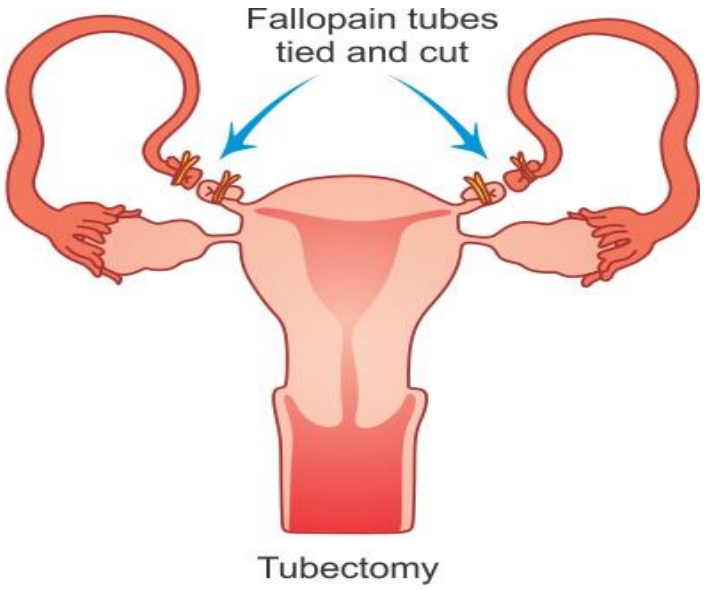
5-**Surgical methods-**

Surgical methods

- Vasectomy
- Sperm ducts are tied or cut
- So no sperm leaves the testes
- Not normaly reversible but extremely reliable

- Laparotomy/tubectomy
- Oviducts are tied or cut
- No eggs/ova can pass down





Sexual transmitted diseases:

- An infection transmitted through sexual contact, caused by bacteria, viruses or parasites.
- The most common STDs are described below.
- Chlamydia. A certain type of bacteria causes chlamydia.
- HPV (human papillomavirus).
- Syphilis.
- HIV.
- Gonorrhoea.
- Pubic lice ('crabs')
- Trichomoniasis.
- Herpes.

Genital herpes-

- A common sexually transmitted infection marked by genital pain and sores.
- Caused by the herpes simplex virus, the disease can affect both men and women.
- Pain, itching and small sores appear first. They form ulcers and scabs.

Human papillomavirus (HPV)

- An infection that causes warts in various parts of the body, depending on the strain.
- Symptoms may include warts on the genitals or surrounding skin.

Chlamydia

- Chlamydia affects people of all ages but is most common in young women.
- Symptoms may include genital pain and discharge from the vagina or penis.
- Antibiotic therapy for the affected patient and the sexual partners of patients is recommended.

Gonorrhea

- Symptoms include painful urination and abnormal discharge from the penis or vagina. Men may experience testicular pain and women may experience pain in the lower stomach. In some cases, gonorrhea has no symptoms.
  Gonorrhea can be treated with antibiotics.

HIV/AIDS

- The virus can be transmitted through contact with infected blood, semen or vaginal fluids.
- Within a few weeks of HIV infection, flu-like symptoms such as fever, sore throat and fatigue can occur
- No cure exists for AIDS,

Syphilis

- A bacterial infection usually spread by sexual contact that starts as a painless sore.
- Syphilis is treated with penicillin. Sexual partners should also be treated.