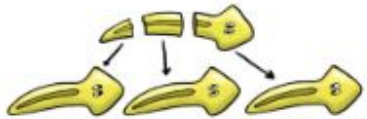
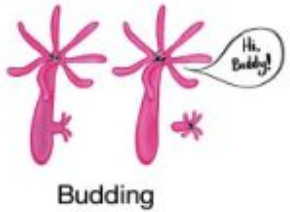
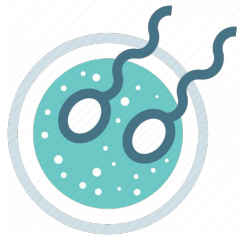
HOW DO ORGANISMS REPRODUCE?





Before we discuss the mechanisms by which organisms reproduce, let us ask a more basic question –

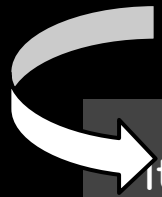
Why do organisms reproduce?



Reproduction is not necessary to maintain the life of an individual organism, unlike the essential life processes such as nutrition, respiration, or excretion.

If an individual organism is going to create more individuals, a lot of its energy will be spent in the process.

So why should an individual organism waste energy on a process it does not need to stay alive?



It ensures the continuity of the species!

Leads to Evolution

Prevents extinction of the species

How do we know that two different individual organisms belong to the same species?

Usually, we say this because they look similar to each other.

Thus, reproducing organisms create new individuals that look very much like themselves.

What is Reproduction?

Reproduction is the process of producing offsprings that are biologically (genetically) same/similar to the parent organism.

DO ORGANISMS CREATE EXACT COPIES OF THEMSELVES?

- Organisms look similar because their body designs are similar. If body designs are to be similar, the blueprints for these designs should be similar.
- Thus, reproduction at its most basic level will involve making copies of the blueprints of body design.

Ques. How does this happen?

- Chromosomes in the nucleus of a cell contain information for inheritance of features from parents to next generation in the form of DNA (Deoxyribonucleic Acid) molecules.
- The DNA in the cell nucleus is the information source for making proteins. If the information is changed, different proteins will be made.
- Different proteins will eventually lead to altered body designs.

importance of DNA copying in reproduction is:-
1) It contains information about inheritance from parents to offsprings.
2) It codes for proteins required by an individual.
3) If DNA is not copied during reproduction, correct proteins will not be formed and the structure of the individual will be entirely different.
4) Errors in DNA copying will lead to evolution.
5) It makes the organism look similar to each other.

A basic event in reproduction is the creation of a DNA copy.

DNA copying accompanied by the creation of an additional cellular apparatus.

But The DNA copying mechanism, cannot be absolutely accurate, and the resultant errors are a source of variations in populations of organisms.

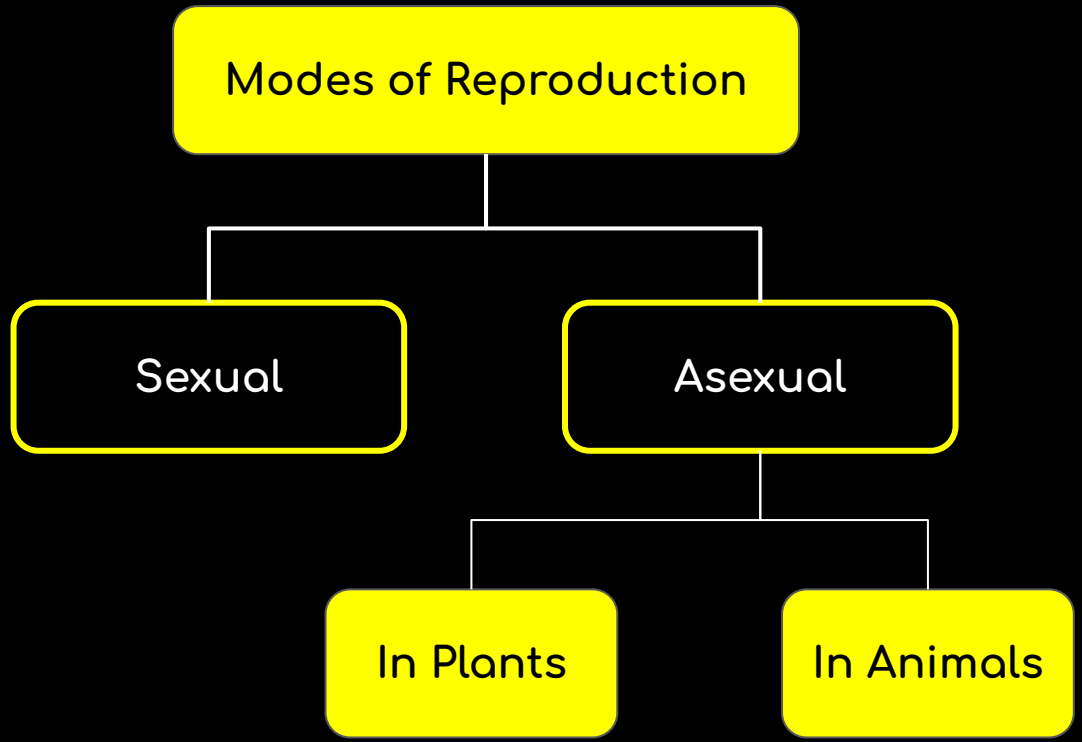
Definition: Differences in the traits of an offspring from their parent. Process of copying the DNA will have some variations each time.

Ques. Why is variation beneficial to the species but not necessarily for the individual?

This inbuilt tendency for variation during reproduction is the basis for evolution.

Increases the chances of survival of the species.

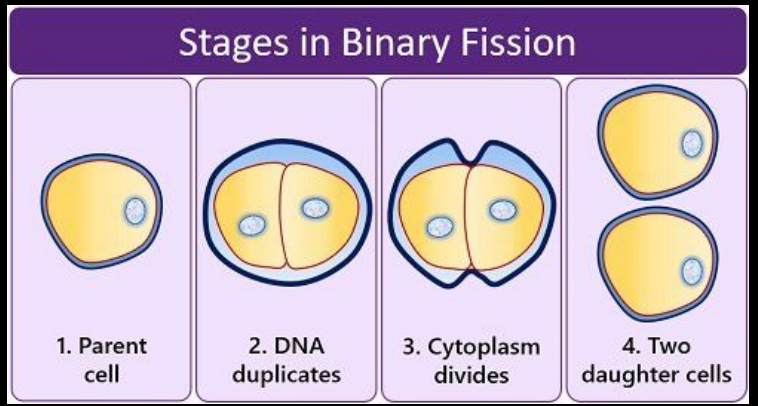
MODES OF REPRODUCTION USED BY SINGLE ORGANISMS

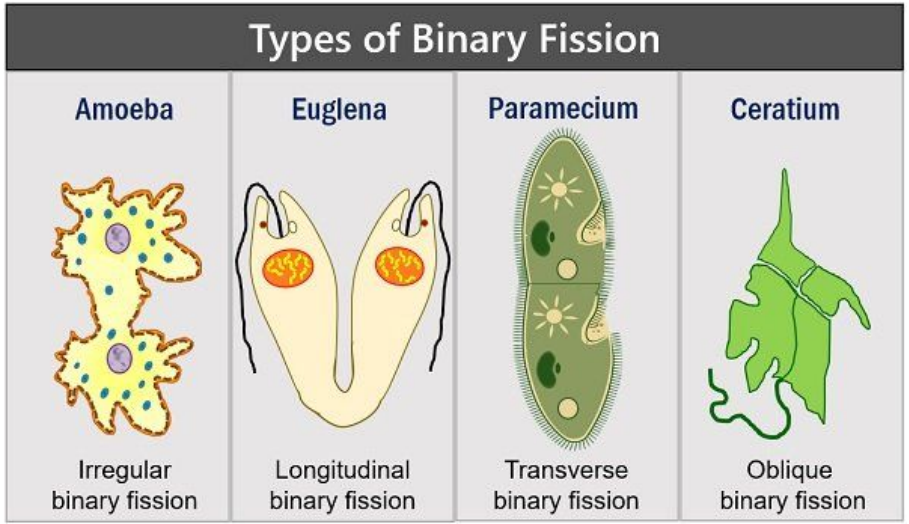

Modes of Reproduction
Sexual
Asexual
In Plants
In Animals

BASIS OF COMPARISON	SEXUAL REPRODUCTION	ASEXUAL REPRODUCTION
Meaning	It is a kind of reproduction where there is the involvement of one or two organisms or individuals.	It refers to the kind of reproduction that involves only one organism.
Organisms Involved	Two parents	One parents
Gamete Formation	Gamete formation occurs	Does not occur
Sex organs	Sex organs are formed	No formation of sex organs
Zygote	Zygote forms through a fusion of gametes.	The zygote does not form.
Inheritance	The offspring inherits characteristics of both parents.	Offspring inherits characteristics of one parent.

FISSION

- Common in most of the unicellular organisms.
- Two types : Binary and Multiple
- When the fission results in two daughter cells, it is binary fission (e.g. paramecium) and when fission results in many daughter cells, it is called multiple fission (e.g. Plasmodium).

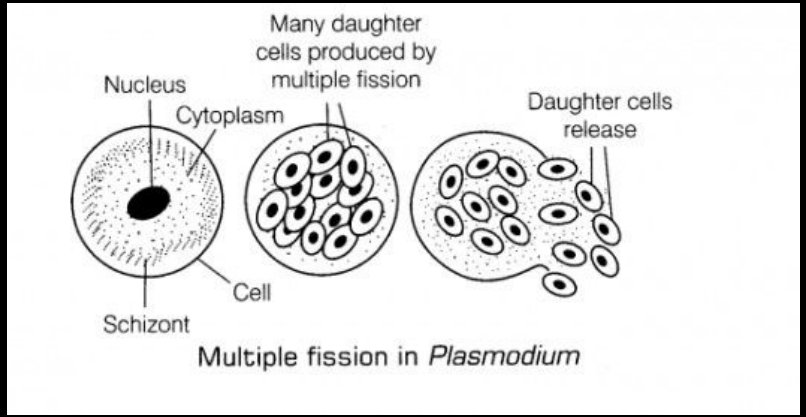




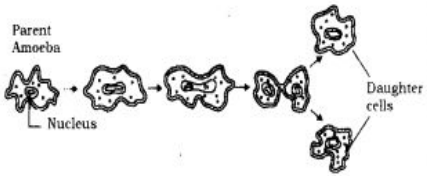
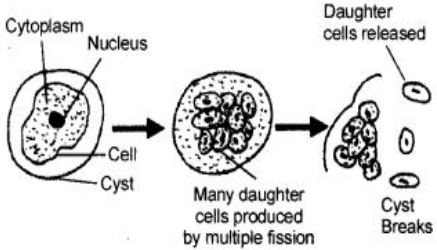
Note : Leishmania causes kala-azar

MULTIPLE FISSION

- Malarial parasite, Plasmodium, divide into many daughter cells simultaneously by multiple fission.
- Yeast, on the other hand, can put out small buds that separate and grow further

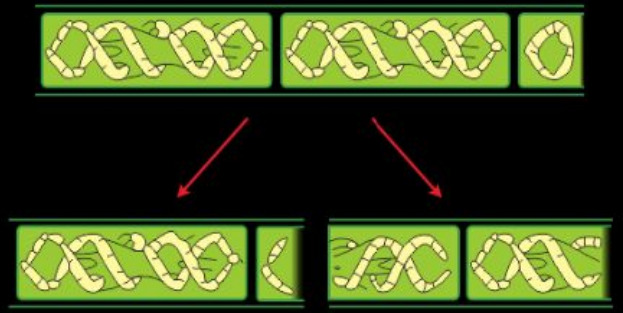


Multiple fission in *Plasmodium*

Binary Fission	Multiple Fission
1. It refers to the division of parent cell into two small, nearly equal sized identical daughter individuals. 2. The parent cell does not break away. Example *Amoeba.*  Binary Fission in Amoeba	1. It refers to the division of parent cell into several small, nearly equal sized daughter individuals. 2. Parent cell breaks away, releasing many individuals at once. Example : *Plasmodium.*  Multiple Fission in Plasmodium

FRAGMENTATION

- In simpler multi-cellular organisms with relatively simple body organisation.
- Spirogyra, for example, simply breaks up into smaller pieces upon maturation. These pieces or fragments grow into new individuals



Spirogyra breaks up into pieces and those pieces grow into new individuals

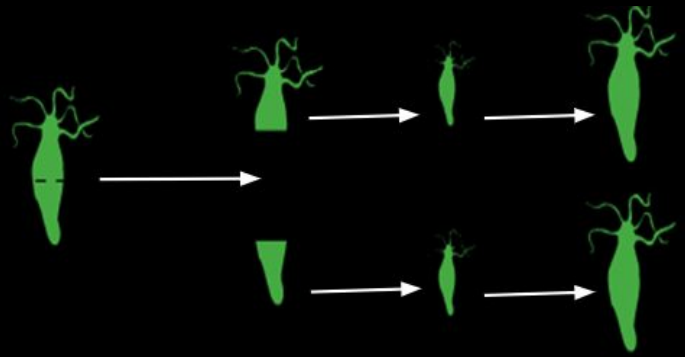
This is not true for all multicellular organisms.

- They cannot simply divide cell-by-cell.
- The reason is that many multicellular organisms, as we have seen, are not simply a random collection of cells.
- Specialised cells are organised as tissues, and tissues are organised into organs, which then have to be placed at definite positions in the body.
- In such a carefully organised situation, cell-by-cell division would be impractical.

Multicellular organisms, therefore, need to use more complex ways of reproduction.

REGENERATION

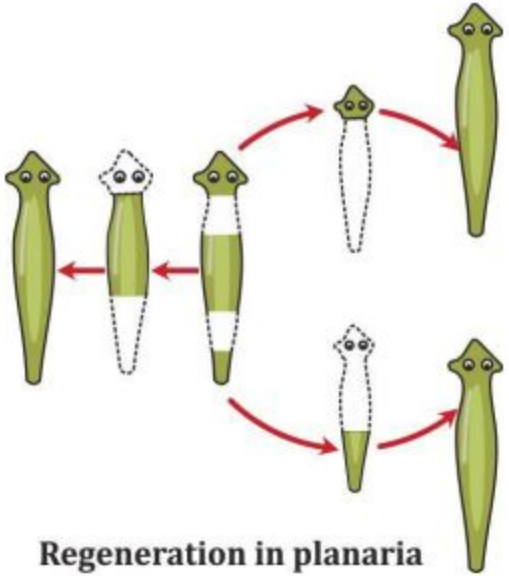
- Refers to the ability to give rise to new individual organisms from their body parts.
- Happens in case of accident if the individual is somehow cut or broken up into many pieces, then many of these pieces grow into separate individuals.



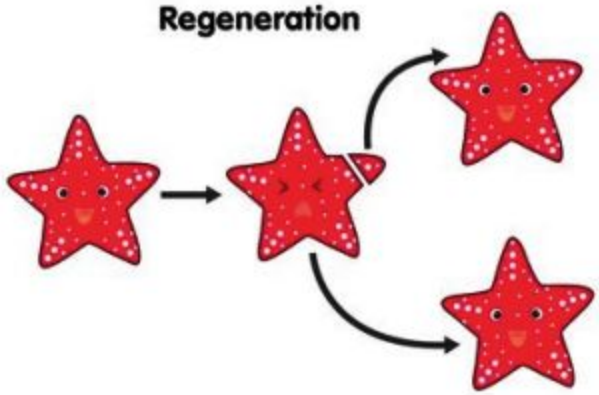
Hydra

Steps in Regeneration:

- Carried out by specialised cells.
- These cells proliferate and make large numbers of cells.
- From this mass of cells, different cells undergo changes to become various cell types and tissues.
- These changes take place in an organised sequence referred to as development.

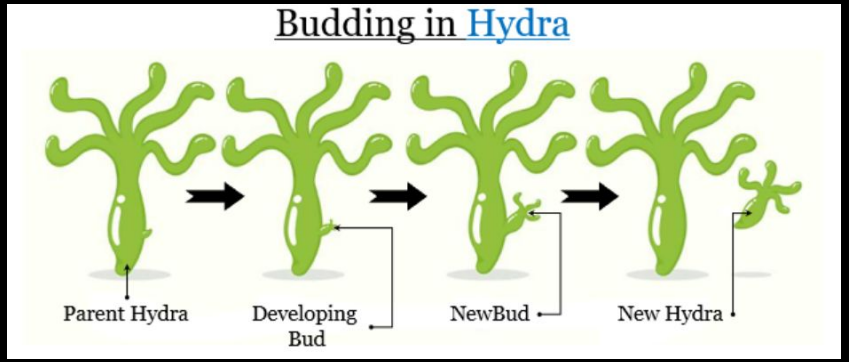


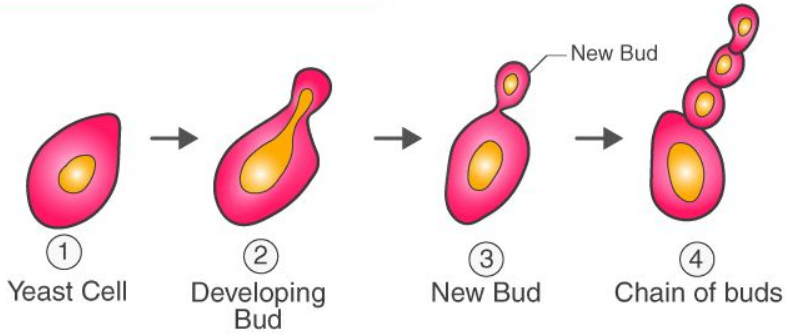
Regeneration in planaria



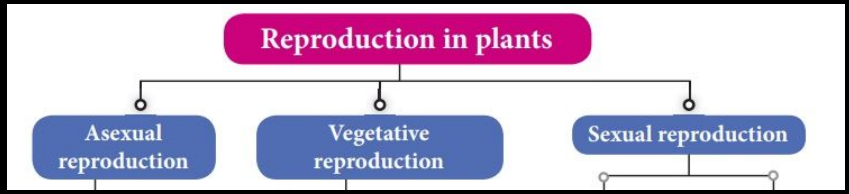
BUDDING

- In Hydra, a bud develops as an outgrowth due to repeated cell division at one specific site.
- These buds develop into tiny individuals and when fully mature, detach from the parent body and become new independent individuals.




New Bud
1
Yeast Cell
2
Developing Bud
3
New Bud
4
Chain of buds

VEGETATIVE PROPAGATION



- By roots: Dahlias, sweet potato.
- By stem: potato, ginger.
- By leaves: bryophyllum (leaf notches bear buds which develop into plants)

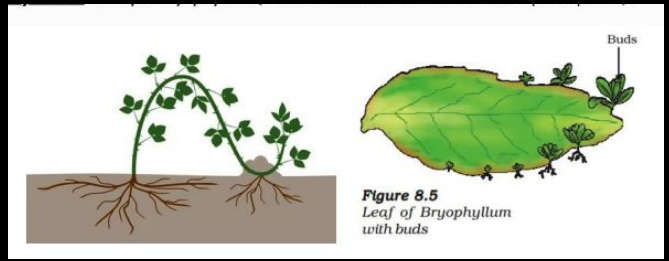


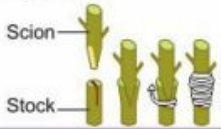
Figure 8.5
Leaf of Bryophyllum with buds

Artificial Vegetative Propagation

Cutting – A part of stem is cut and the cut end grows into new plant when placed in moist soil
e.g. mango, guava, litchi, lemon, rose

Layering – The stem of a plant is bent down until it touches the soil. The stem is then cut once it develops roots and grows into a new plant e.g. lemon, rose, jasmine

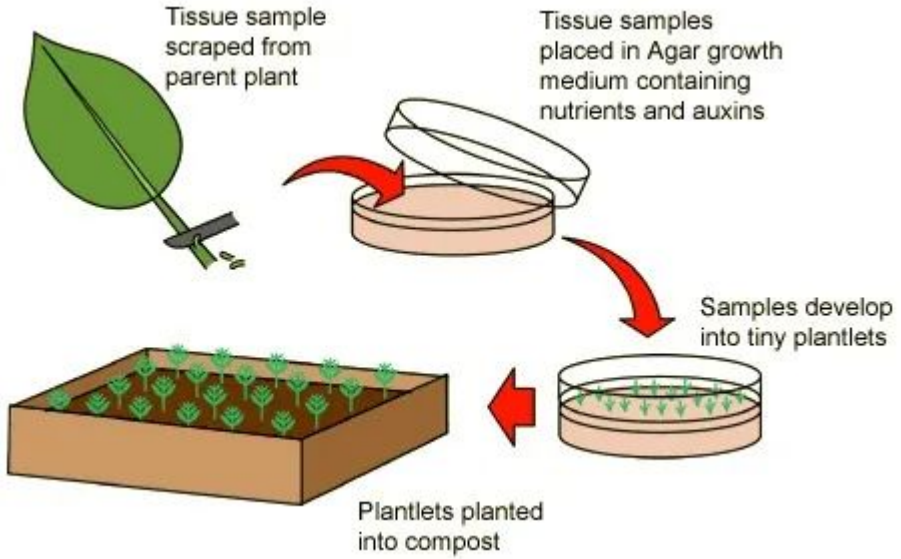
Grafting – The stem of a plant is cut and then fitted on another strong plant and covered with grafting wax.
e.g. apples, oranges, water melon, ornamental plants



Tissue culture - A collection of techniques used to maintain or grow plant cells, tissues or organs under sterile conditions on a nutrient culture medium of known composition

Advantages of Vegetative Reproduction

- Quicker than sexual reproduction in plants.
- Variations can be controlled
- Helps the plants that cannot even produce seeds. (eg. Banana)
- Flowers produced are of superior quality.
- Plants produced are genetically similar to the parent plant



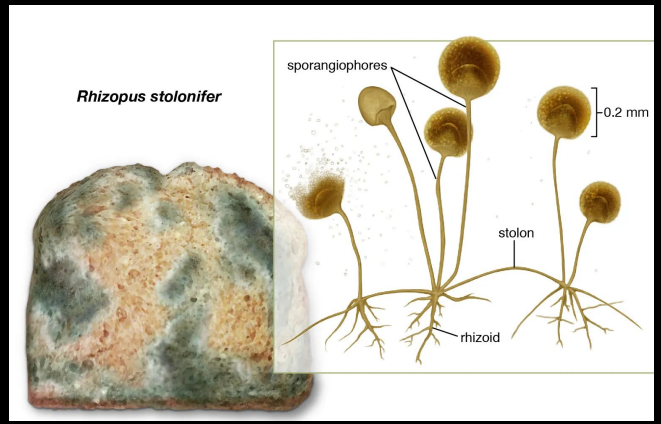
Homework :

What is the other name of Tissue Culture?

SPORE FORMATION

- Spore Formation is **an Asexual Reproduction technique**. Many Spores are housed in sacs known as Sporangia. The plants produce hundreds of spores and the spore sac bursts. These spores are dispersed into the air, where they germinate and create a new plant under favourable conditions.

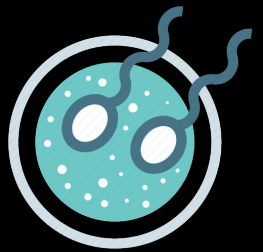
- **The spores are covered by thick walls that protect them until they come into contact with another moist surface and can begin to grow.**



SEXUAL REPRODUCTION

CHARACTERISTICS OF SEXUAL REPRODUCTION

- Two parents- a male and female, are involved.
- Gametes formation occurs through meiotic cell division.
- Male gamete called sperm and female gamete called ovum or egg are formed in respective parents.
- Fertilization takes place to form zygote.
- The offspring are genetically and physically dissimilar from the parent.
- Most variations are produced during sexual reproduction.
- Small number of offspring is produced.
- Parental care is present.

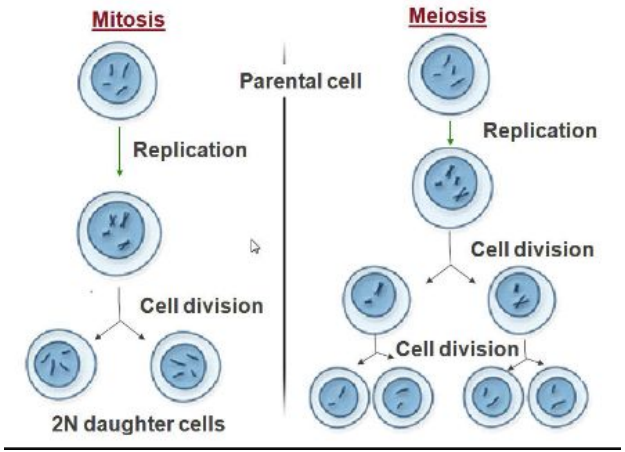


- Sexual reproduction takes place by the combination of special reproductive cells called ‘sex cells’.

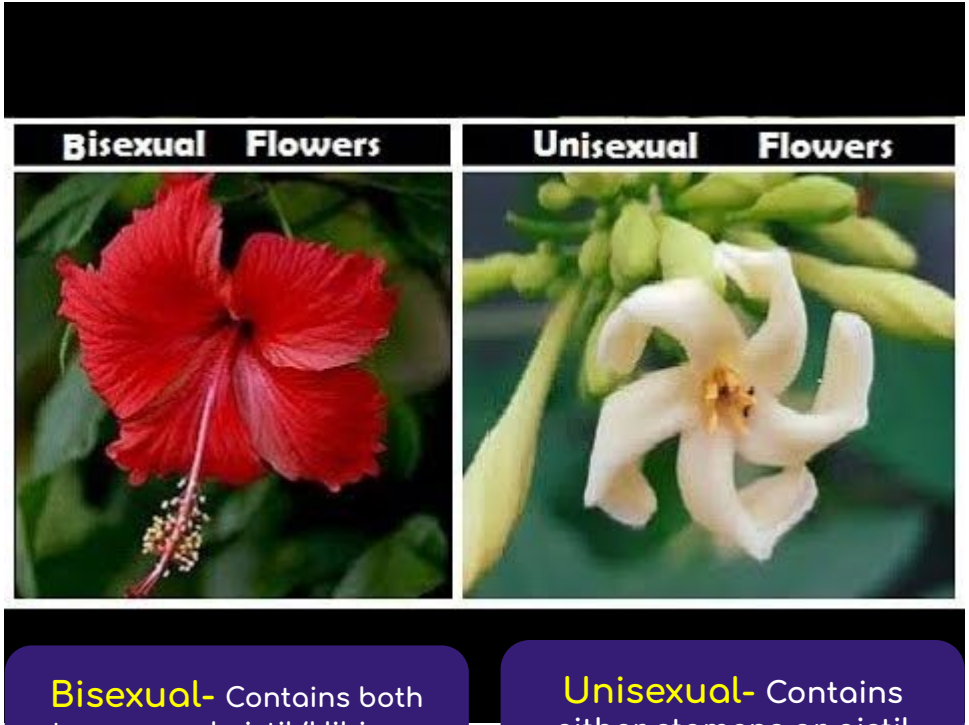
- In sexual reproduction, a male gamete fuses with a female gamete to form a new cell called ‘zygote’.

- This zygote then grows & develops into a new organism in due course of time.

MITOSIS	MEIOSIS
• One division. • No of chromosomes remains the same. • Two daughter cells are formed. • It takes place in both Haploid cells and diploid cells.	• Two divisions. • No. of chromosomes is halved. • Four daughter cells are formed. • • It takes place only in diploid cells.

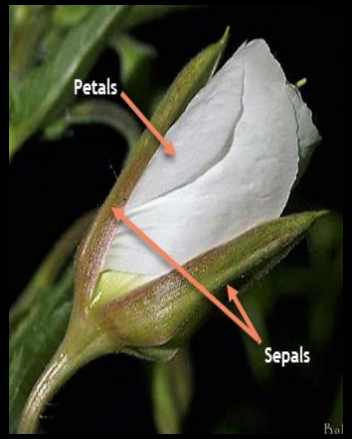


SEXUAL REPRODUCTION IN FLOWERING PLANTS



Bisexual- Contains both stamens and pistil (Hibiscus, Mustard)

Unisexual- Contains either stamens or pistil (Papaya, watemelon)



SEPALS

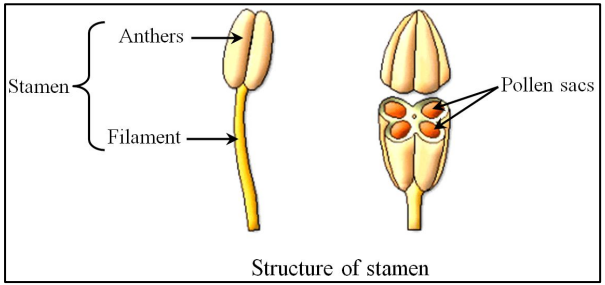
- The green outermost circle of a flower are called sepals. All sepals taken together are called- 'calyx'.
- The function of sepals is to protect the flower in its initial stages when it is in the form of a bud.

PETALS

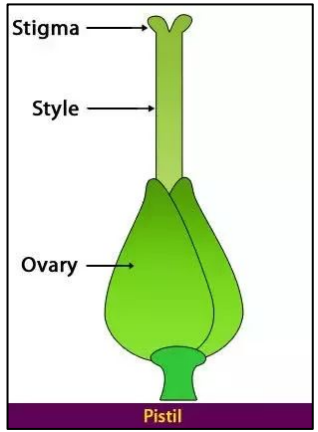
- The colorful parts of a flower are called petals. The petals lie inside the sepals. All petals together are called 'Corolla'.
- The petals are usually scented.
- Function of petals is to attract insects (for pollination)

- Androecium (Stamen) and gynoecium (pistil or carpel) are reproductive parts of a flower.

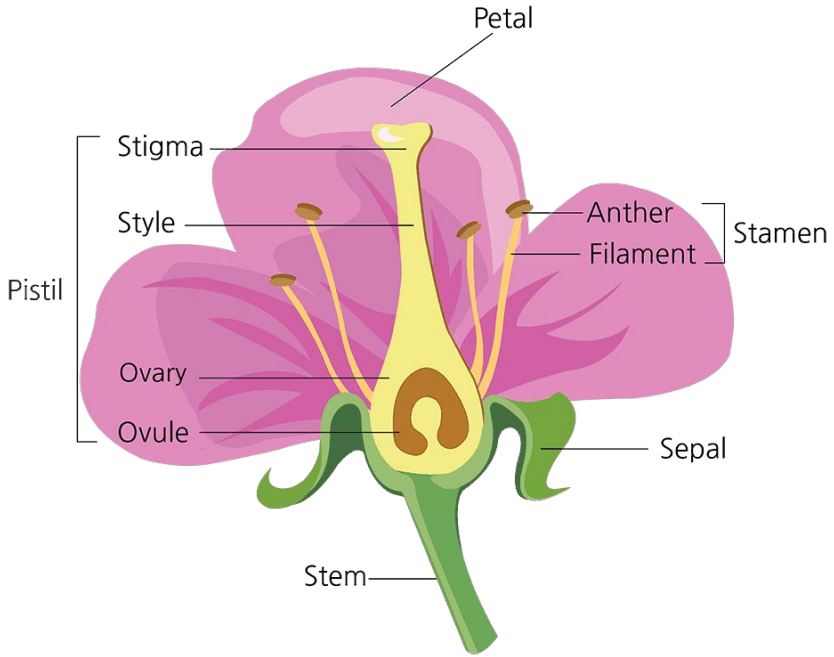
- Androecium(anther + filament) produces pollen grains containing male gametes
- Gynoecium (stigma + style + ovary) produces ovules which are female gametes.



Structure of stamen



- The plants in which the sex organs are carried within the flowers are called angiosperms.
- Angiosperm are commonly known as flowering plants.
- The flowering plants reproduce by 'sexual reproduction' method.
- This implies- 2 sexes (male & female) are involved in reproduction in flowering plants.

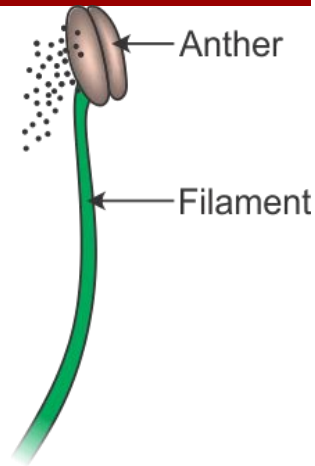


Male Reproductive Part : Stamen

Anther produces the pollen grains in a process called microsporogenesis.

Internally, each anther lobe consists of two long & cylindrical pollen sacs or microsporangia.

The filament is long, slender stalk. It supports the anther.



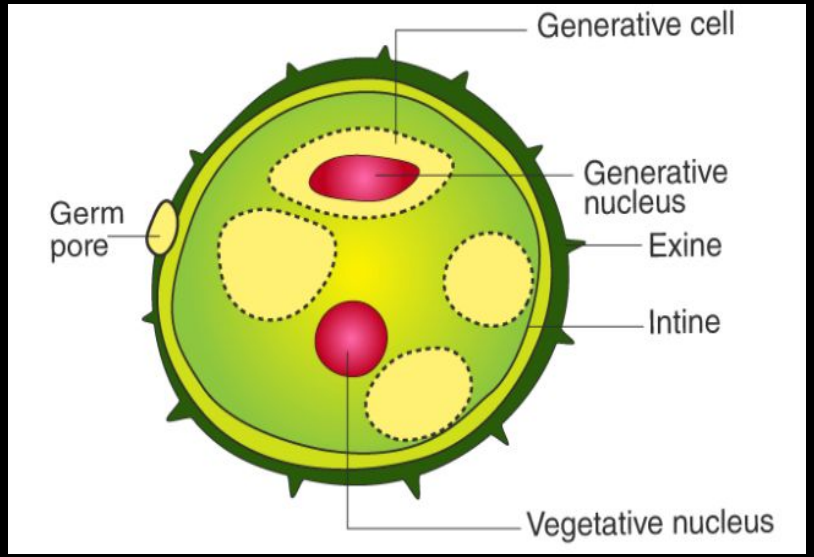
Structure of Pollen Grains

Generative Cell- Generative cell is spindle-shaped with dense cytoplasm and nucleus. Generative cell floats in the cytoplasm of vegetative cell

Exine- Hard outer layer

Intine- Inner layer composed of cellulose & pectin

Vegetative Nucleus- In pollen grains, the known function of the vegetative cell is to extend a pollen tube to transport the two sperm cells to the embryo sac for fertilization.



Parts of Pollen Grains

Germ pore- Germ pore plays an essential part in the fertilization of plants. It helps in pollen tube formation and releases the male gamete during fertilization

Generative nucleus- Generative nucleus is a nucleus of a flowering plant that is present in the pollen grain of the plant. It helps in the formation of new sperm nuclei. It produces the male gamete in the pollen tube of the flowering plant by dividing itself.

Female Reproductive Part

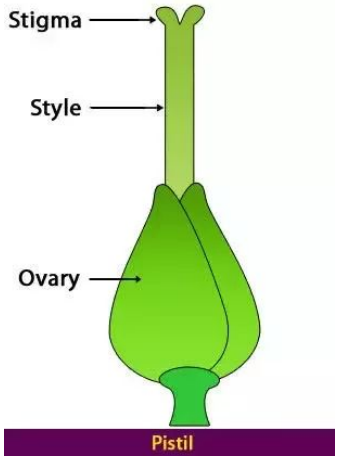
Ovary- The swollen bottom part.

Style- Middle elongated part.

Stigma- Terminal part which may be sticky.

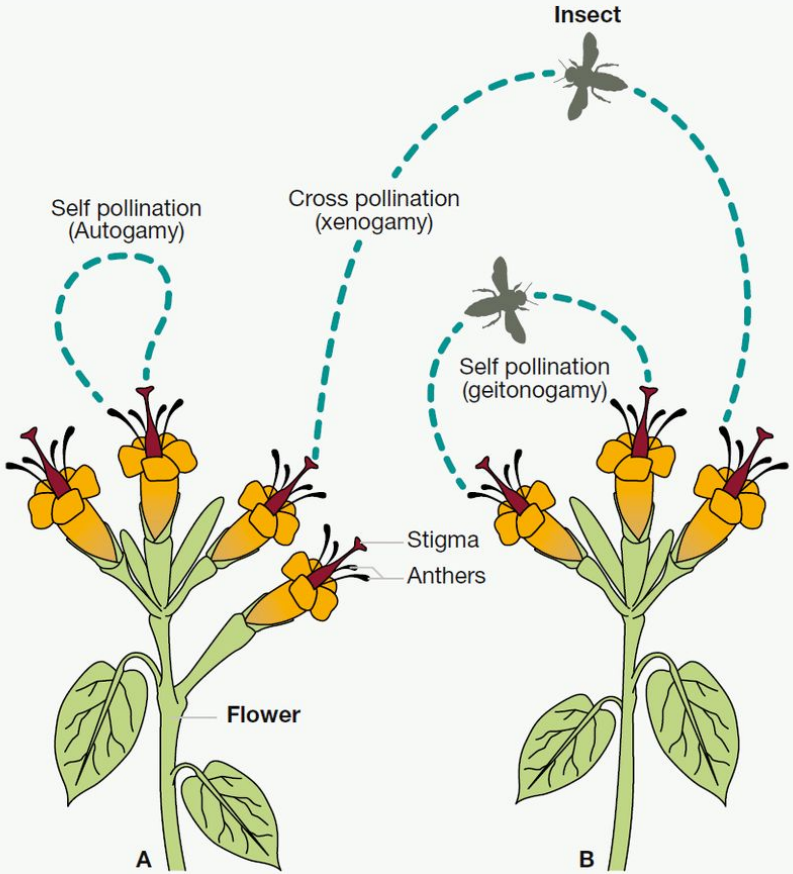
Ovary contains ovules & each ovule has an egg cell.

But how does male gamete reaches the egg?



Types of Pollination

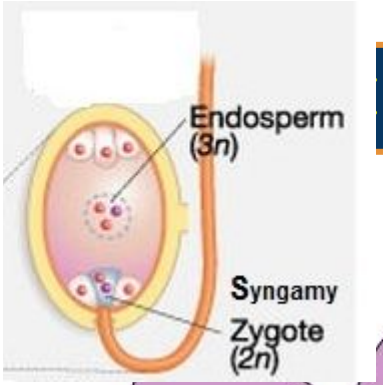
In self-pollination, transfer of pollen grains takes place from anthers to the stigma of the same flower or another flower of the same plan

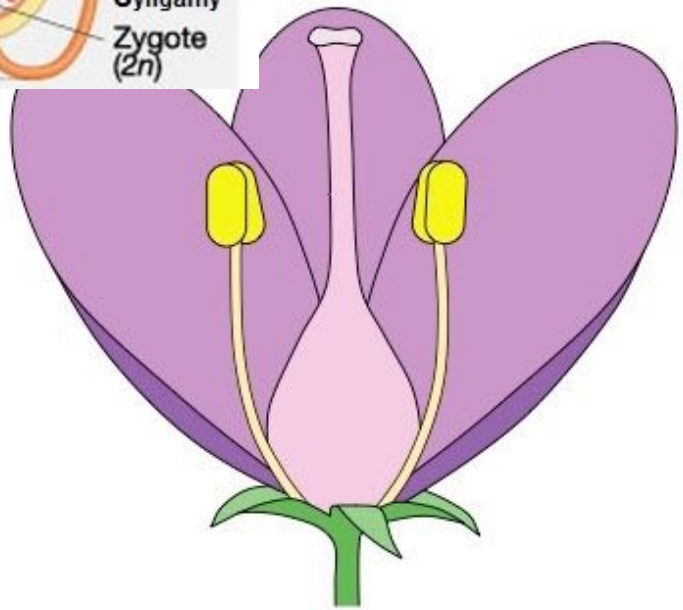


FERTILISATION

Fusion of male and female gametes is known as fertilization.

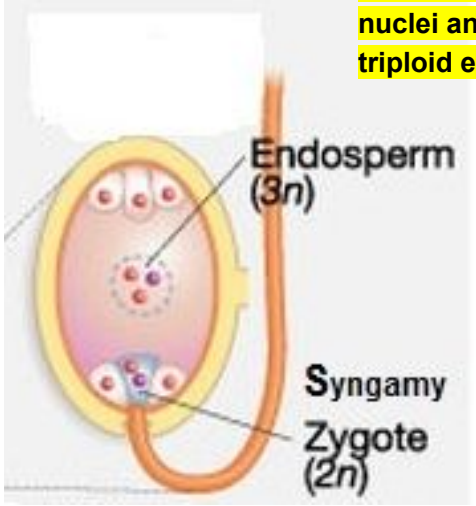
- In flowering plants after pollination, the pollens germinate on the stigma surface of pistil and generate two male nuclei.
- After the pollen lands on a suitable stigma, it has to reach the female germ-cells which are in the ovule.
- For this, a tube grows out of the pollen grain and travels through the style to reach the ovule.
- Ovule has egg cell and two polar nuclei.





DOUBLE FERTILISATION

- One male nucleus fuses with two polar nuclei and forms triploid endosperm



- Another male nucleus fuses with the egg cell and forms the zygote that gives rise to the embryo and future plant.

Syngamy can be defined as the process of fusion of egg nucleus with male gamete to form a diploid zygote. (2n).

Triple fusion can be defined as the fusion involving two polar nuclei and a sperm nucleus that occurs in double fertilization in a seed plant, giving rise to a triploid nucleus called the primary endosperm nucleus, which later develops into the endosperm.

PEC- Function- to provide nourishment to the plant

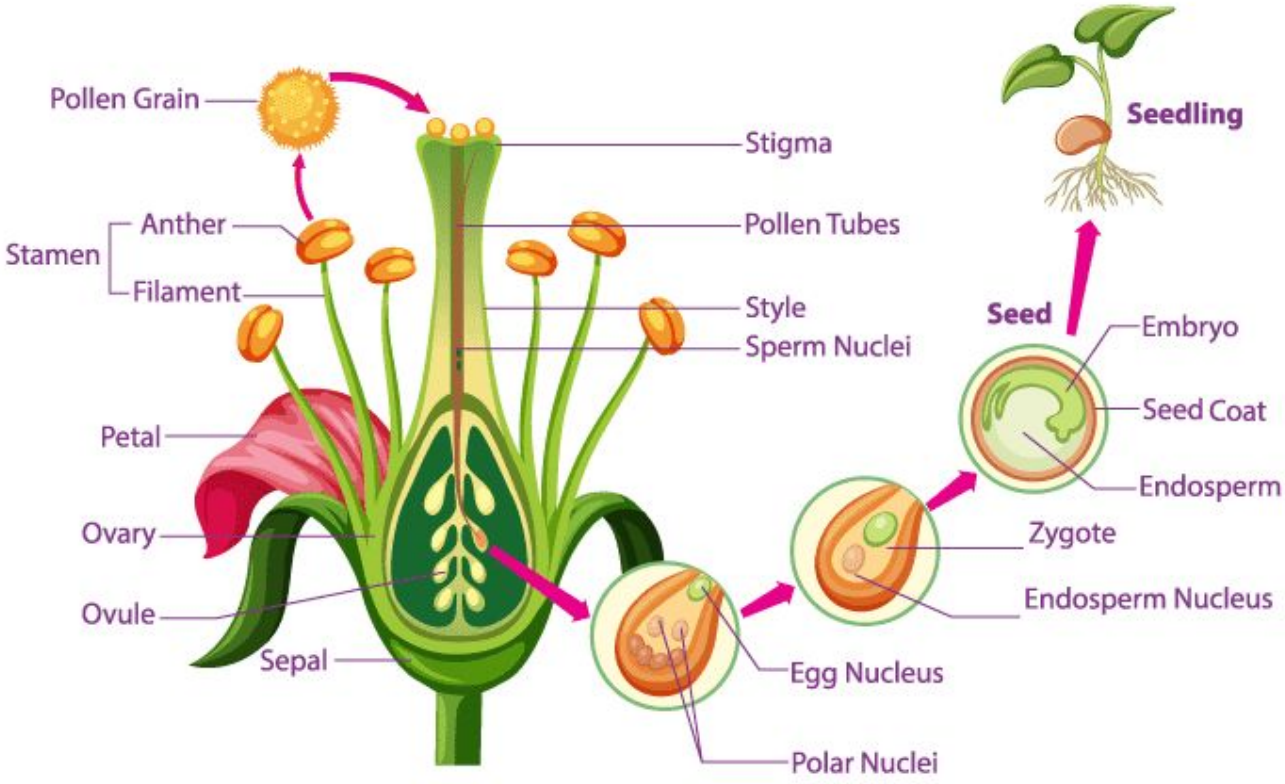
POST-FERTILISATION

After fertilisation, the petals, sepals, stamens, style and stigma may shrivel and fall off.

After fertilisation, the zygote divides several times to form an embryo within the ovule.

The ovule develops a tough coat and is gradually converted into a seed.

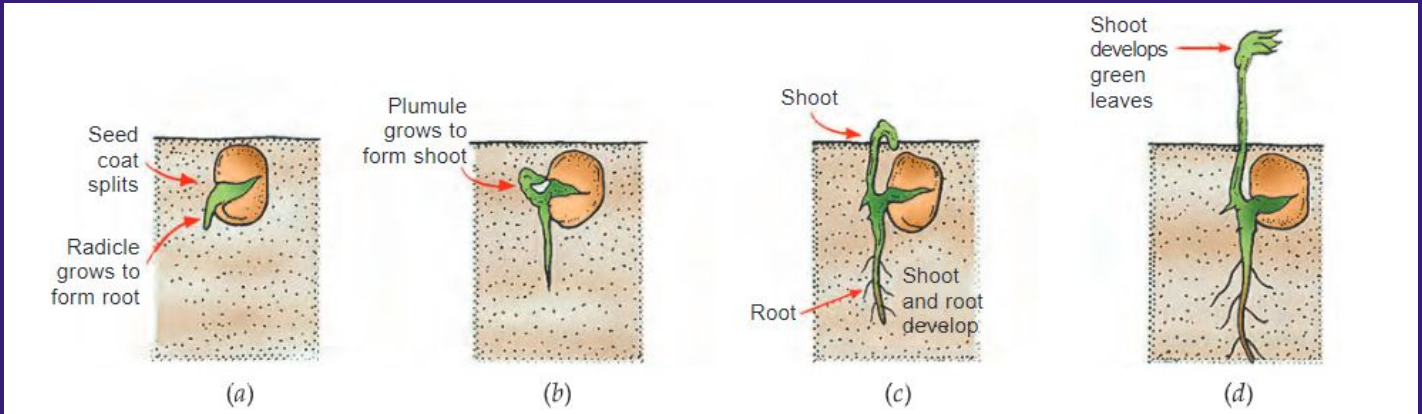
When the seed gets suitable conditions like water, air, warmth, etc- it germinates & a new plant grows.


Pollen Grain
Stigma
Anther
Stamen
Filament
Pollen Tubes
Style
Sperm Nuclei
Petal
Ovary
Ovule
Sepal
Egg Nucleus
Polar Nuclei
Zygote
Endosperm Nucleus
Seed
Embryo
Seed Coat
Endosperm
Seedling

Homework : What is GERMINATION?

GERMINATION OF SEEDS

- Germination begins when the seed absorbs water, swells and bursts through the seed coat.
- The water helps the enzymes to function in the seed. The enzymes digest the stored food in cotyledons & make it soluble.
- This soluble food makes the radicle & plumule present in the seed to grow.



SEXUAL REPRODUCTION IN HUMAN BEINGS

PUBERTY

The age at which the sex hormones (or gametes) begin to be produced and the boy and girl become sexually mature (able to reproduce) in called puberty.

Boys attain puberty at the age of 13 to 14 years, while girls reach puberty at a comparatively lower age of 10 to 12 years.

Some of these changes are common to both boys and girls :

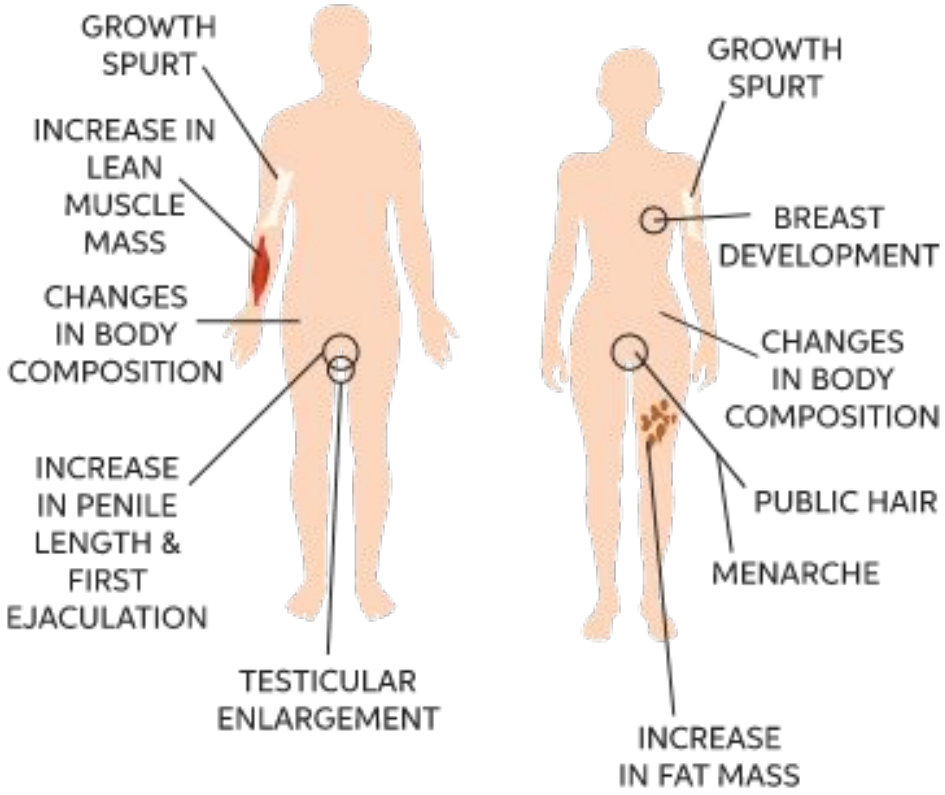
Thick hair growing in new parts of the body such as armpits and the genital area between the thighs, which can also become darker in colour.

Thinner hair can also appear on legs and arms, as well as on the face.

The skin frequently becomes oily and we might begin to develop pimples.

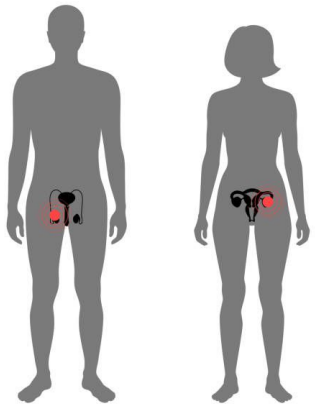
In girls, breast size begins to increase,
with darkening of the skin of the nipples at the tips of the breasts.
girls begin to menstruate at around this time.

Boys begin to have new thick hair growth on the face and their voices begin to crack.
Further, the penis occasionally begins to become enlarged and erect, either in daydreams or at night.



These changes take place :

- Slowly
- Happen early and quickly in some, while in others, they can happen slowly.
- Show differences between people.

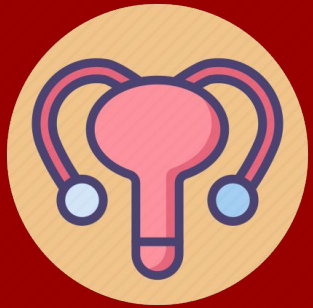


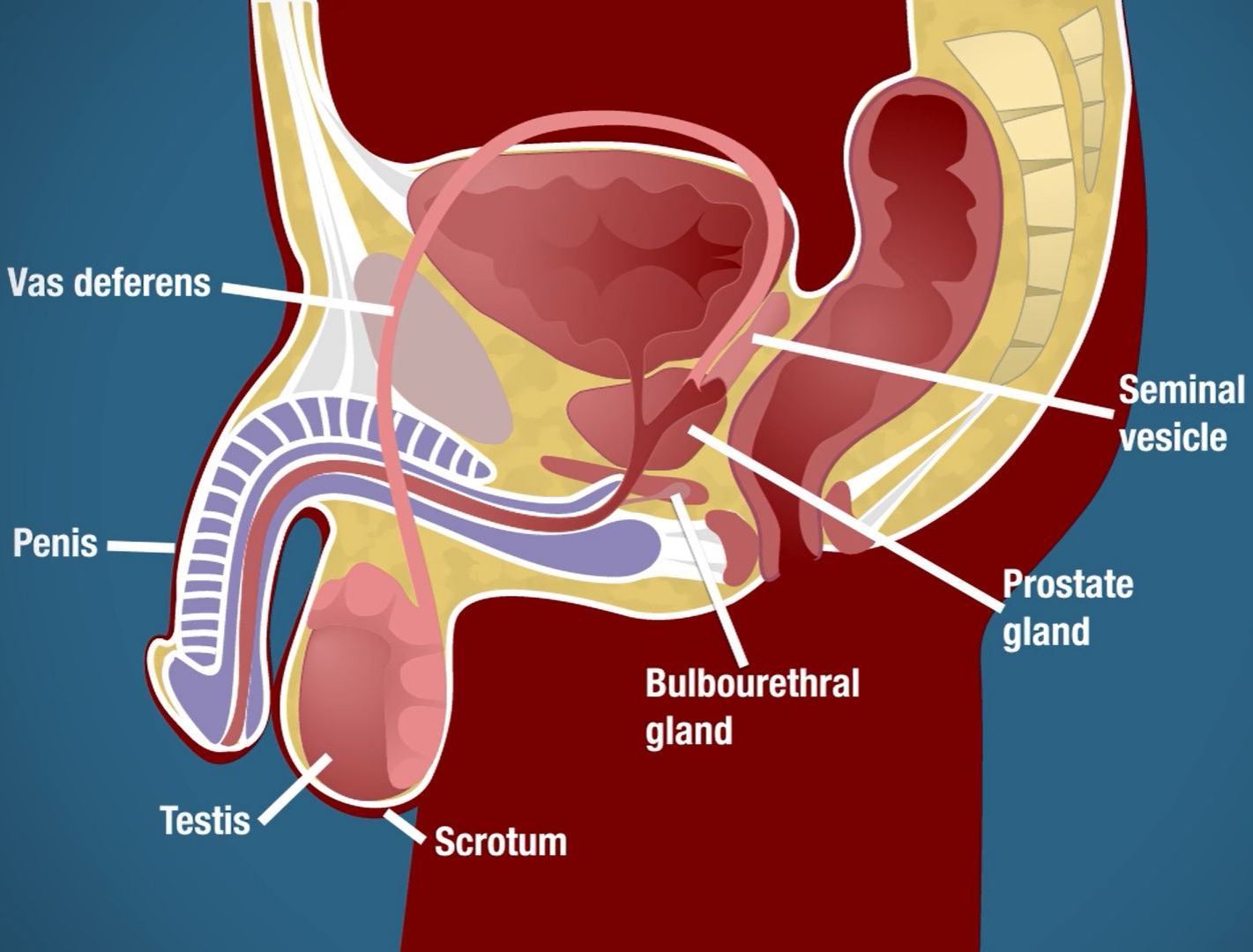
The sexual mode of reproduction means that germ-cells from two individuals have to join together for the process of MATING.

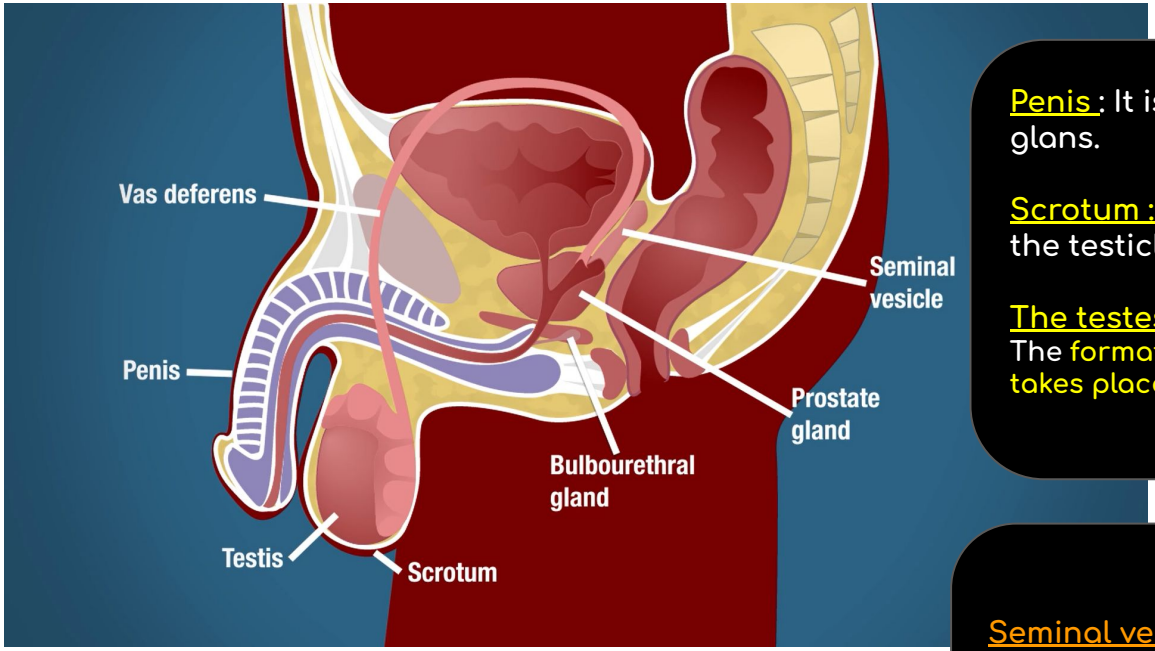
Male Reproductive System

Primary Sex Organ- Pair of Testes

Secondary Sex Organ- Accessory Ducts & Glands




Vas deferens
Penis
Testis
Scrotum
Bulbourethral gland
Prostate gland
Seminal vesicle



Penis : It is the main organ. It has 3 parts : root, shaft, glans.

Scrotum : is the loose pouch-like sac of skin that holds the testicles

The testes : Primary sex organs that make testosterone. The formation of germ-cells or sperms (spermatogenesis) takes place in the testes.

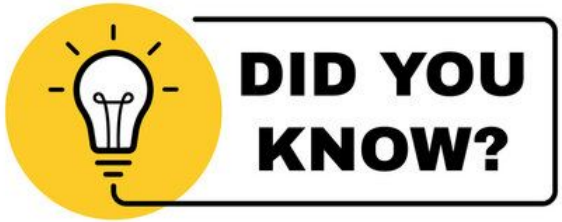
Seminal vesicles: They make a sugar-rich fluid (fructose) that provides sperm with a source of energy and helps in motility.

Prostate gland: contributes additional fluid to the ejaculate. Prostate fluids also help to nourish the sperm.

What are sex hormones?

Hormones secreted by the sex organs of organisms which affect the growth and functioning of the reproducting organs and develop secondary sexual characteristics are known as SEX HORMONES.

Hormone	Gender	Source of Production
Testosterone	Male	Testes
Estrogen	Female	Ovaries
Progesterone	Female	Ovaries and Placenta



The formation of germ-cells or sperms takes place in the testes. These are located outside the abdominal cavity in scrotum because sperm formation requires a lower temperature than the normal body temperature.

Homework

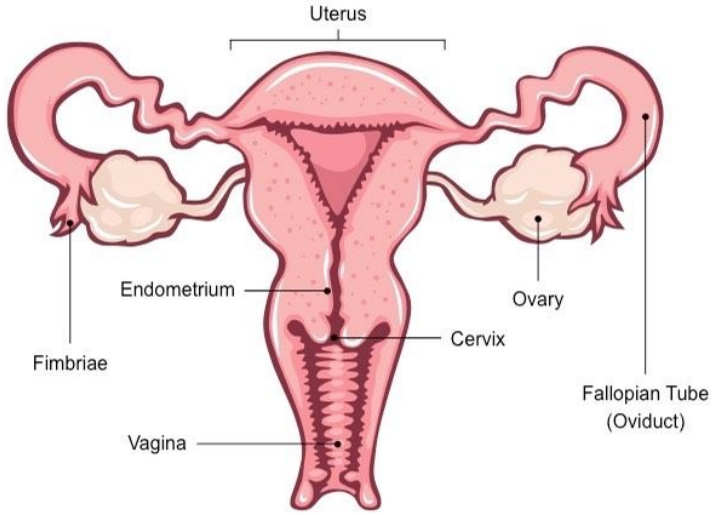
Function of :

- **Testosterone**
- **Estrogen**

Female Reproductive System

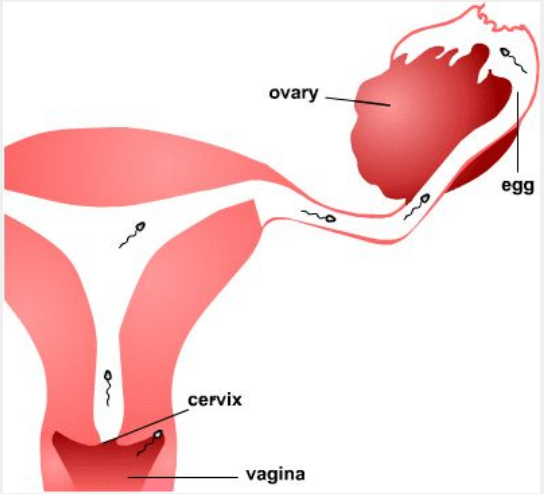
Primary Sex Organ- Pair of Ovaries

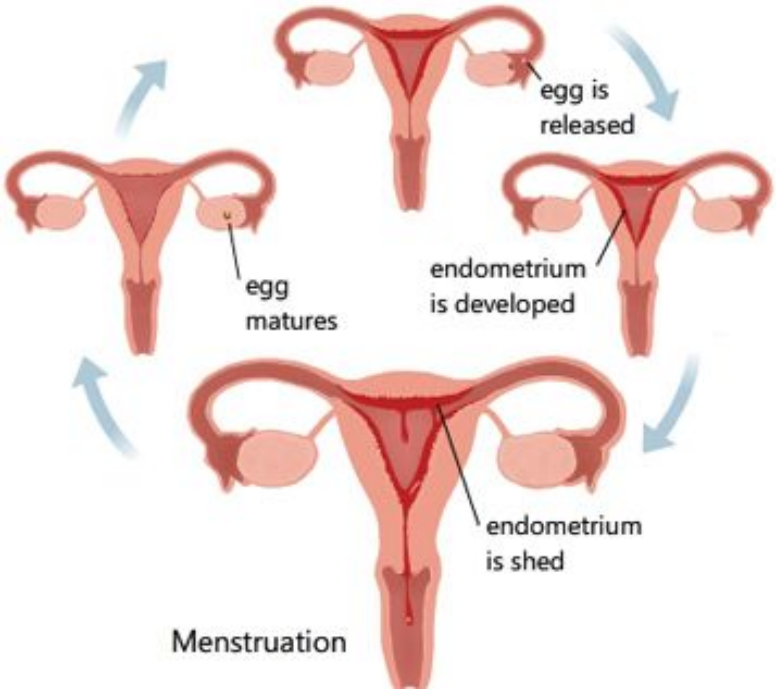
Secondary Sex Organ : Internal (fallopian tube, uterus, cervix, vagina) + external (labia majora, labia minora and clitoris)



Fertilisation in Humans

- The sperms enter through the vaginal passage during sexual intercourse.
- They travel upwards & reach the oviduct where they may encounter the egg (INSEMINATION).
- Fertilisation happens in fallopian tube. The fertilised egg (zygote) starts dividing and form a ball of cells or embryo.
- The embryo is implanted in the lining of the uterus where they continue to grow and develop organs to become foetus. (GESTATION)
- The embryo gets nutrition from the mother's blood with placenta.





What happens when the Egg is not Fertilised?

If the egg is not fertilised, it lives for about one day.

Menstrual Cycle :

Menstruation is the cyclic event of the release of the ovum from the ovary and its removal from the body when fertilization does not happen

Uterus lining which becomes thick and spongy for nourishing the embryo, breaks and comes out through the vagina as blood and mucous when fertilization doesn't occur.

It usually lasts for about two to eight days.

Reproductive health

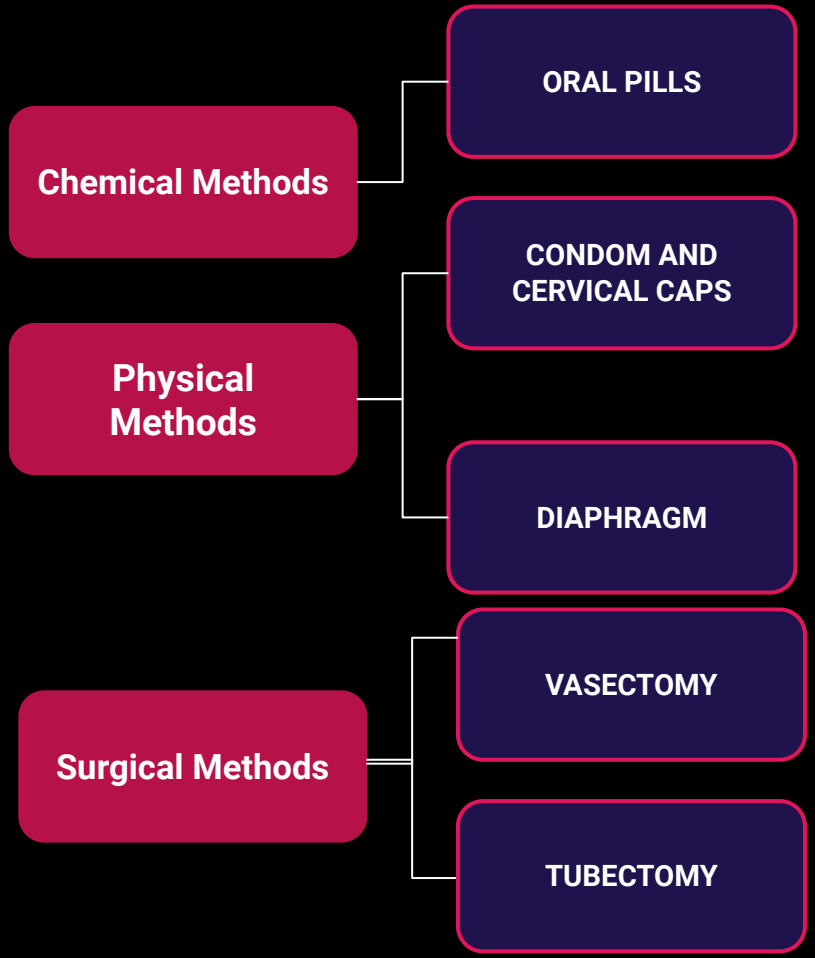
Reproductive Health is a state of complete physical, mental and social well-being in all aspects of reproduction.

SEXUALLY TRANSMITTED DISEASE :

An infection transmitted through sexual contact, caused by bacteria, viruses or parasites

- Gonorrhea,
- Syphilis,
- Genital herpes,
- Chlamydiasis,
- Genital warts,
- Trichomoniasis,

  Hepatitis-B, and HIV.


Chemical Methods
ORAL PILLS
Physical Methods
CONDOM AND CERVICAL CAPS
DIAPHRAGM
Surgical Methods
VASECTOMY
TUBECTOMY

Birth Control Methods

There are **five types of birth control methods** from which to choose according to one's health, relationship status, lifestyle, and reproductive plans.

STERILIZATION METHODS	LONG-ACTING METHODS	SHORT-ACTING METHODS	BARRIER METHODS	NATURAL RHYTHM METHODS
*permanent	*reversible	*reversible	*reversible	*reversible
Tubal ligation 	IUD 	Pills 	Condoms 	Natural family planning 
		Patches 	Diaphragms 	
Male vasectomy 	Implants 	Shots 	Sponges 	Withdrawal 
		Rings 	Cervical caps 	

Mechanical methods: These are used to prevent the passage of semen to the fallopian tube :

(i) Use of condoms: Condoms are thin rubber tubes worn over the penis before sexual intercourse. The semen gets collected in this and is not discharged into the vagina.

(ii) Diaphragm: It is a thin rubber fixed over a flexible metal ring which is fitted over the cervix in a woman's body by a doctor.

(iii) Intra Uterine Contraceptive Device (IUCD) (COPPER T)
It is inserted in the uterus and its insertion causes certain secretion which prevents the implantation of the embryo in the uterine wall.

Chemical methods

- Use of spermicides: These are strong sperm-killing chemicals available in the form of creams, jellies etc. which are injected into the vagina just before copulation.
- Oral contraceptive pills: These are hormonal pills which prevent ovulation but do not stop menstruation.

Surgical methods

- Vasectomy & tubectomy : cutting and ligating OF the vas deferens in males and the fallopion tubes in females.
- Medical termination of pregnancy (MTP) or abortions


Thank
You

NCERT Questions

1. Asexual reproduction takes place through budding in
   (a) *amoeba.*
   (b) yeast.
   (c) *plasmodium.*
   (d) *leishmania.*
2. Which of the following is not a part of the female reproductive system in human beings?
   (a) Ovary
   (b) Uterus
   (c) Vas deferens
   (d) Fallopian tube
3. The anther contains
   (a) sepals.
   (b) ovules.
   (c) pistil.
   (d) pollen grains.

4. What are the advantages of sexual reproduction over asexual reproduction?
5. What are the functions performed by the testis in human beings?
6. Why does menstruation occur?
7. Draw a labelled diagram of the longitudinal section of a flower.
8. What are the different methods of contraception?
9. How are the modes for reproduction different in unicellular and multicellular organisms?
10. How does reproduction help in providing stability to populations of species?
11. What could be the reasons for adopting contraceptive methods?

FRAGMENTATION	REGENERATION
Organisms that are fragmented result in each fragment growing into an individual organism	Regeneration occurs when an organism only re-grows a lost limb or any other part of the body.
A new individual emerges from each fragment	No new organisms are formed
Only a few organisms can fragment and form new individuals	All organisms exhibit the ability to regenerate (Only to some degree)
Fragmentation is observed in organisms such as flatworms and sponges	Examples of regeneration include regrowing a lost limb, such as the tail of a lizard. (Please note: Most lizards can lose their tails and then have them grow back. But if they lose their forelimb or hindlimb, it will not regrow)

Primary sex characteristics: Characteristics involved directly with reproduction:

- Penis
- Vagina
- Fallopian tubes
- Uterus
- Testicles
- Prostate gland

Secondary sex characteristics: Characteristics distinguishing males from females but not specifically associated with reproduction:

- Voice
- Body shape wide shoulders and narrow hips for men.
- Facial and body hair
- Breasts
- Adams apple

Ovaries

1. The pair of ovaries are primary sex organs. They form the ovum and secrete the female hormones - estrogen and progesterone.

2. These are oval shaped organ located one on each side of the lower abdomen.

When a girl is born, the ovaries already contain thousands of immature eggs.

On reaching puberty, some of these start maturing. One egg is produced every month by one of the ovaries. The egg is carried from the ovary to the womb through a thin oviduct or fallopian tube. The two oviducts unite into an elastic bag-like structure known as the uterus. The uterus opens into the vagina through the cervix.

- While DNA-copying mechanisms are not absolutely accurate, they are precise enough to make the generation of variation a fairly slow process.

- If the DNA copying mechanisms were to be less accurate, many of the resultant DNA copies would not be able to work with the cellular apparatus, and would die.

So how can the process of making variants be speeded up?

- Each new variation is made in a DNA copy that already has variations accumulated from previous generations.

- Thus, two different individuals in a population would have quite different patterns of accumulated variations.

Since all of these variations are in living individuals, it is assured that they do not have any really bad effects.

Combining variations from two or more individuals would thus create new combinations of variants.

Each combination would be novel, since it would involve two different individuals.

The sexual mode of reproduction incorporates such a process of combining DNA from two different individuals during reproduction.

Why the sexual mode of reproduction?

- The creation of two new cells from one involves copying of the DNA as well as of the cellular apparatus.
- The DNA copying mechanism, cannot be absolutely accurate, and the resultant errors are a source of variations in populations of organisms.
- Every individual organism cannot be protected by variations, but in a population, variations are useful for ensuring the survival of the species.
- It would therefore make sense if organisms came up with reproductive modes that allowed more and more variation to be generated.