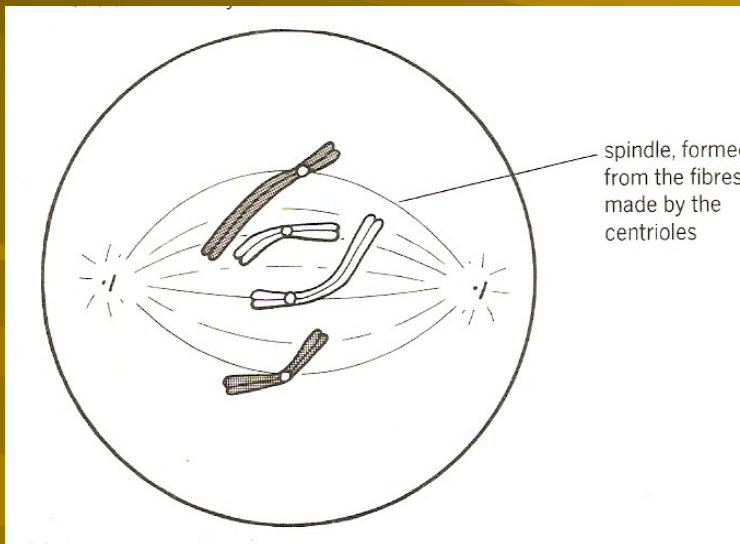
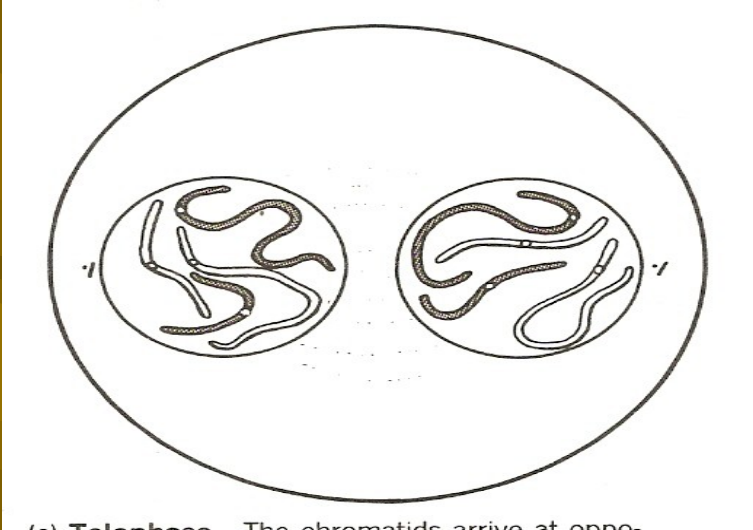


# Chromosomes



- Chromosomes are threadlike structures that are found in the nucleus
- Each plant or animal cell has a fixed number of chromosomes
- This number varies from one species to another.
- Each chromosome is made up of two parallel strands called the chromatids .
- Each pair of chromatid is connected at one point by a structure called the centromere.
- Chromosomes always

- The two chromosomes constituting a pair are called homologous chromosomes .
- Homologous chromosomes are alike i.e they are identical in size and structure ( appearance) although the genetic constitution or composition may be different.
- One member of the pair is the progeny of the chromosome that was derived from the sperm, while the other is a progeny of the chromosome that was derived from the egg.
  - each parent contributes one chromosome that constitutes the homologous pair .
- Chromosomes are present in the nucleus all the time but they only appear or become visible when viewed under a microscope during the cell division.

# TYPES OF CELL DIVISION

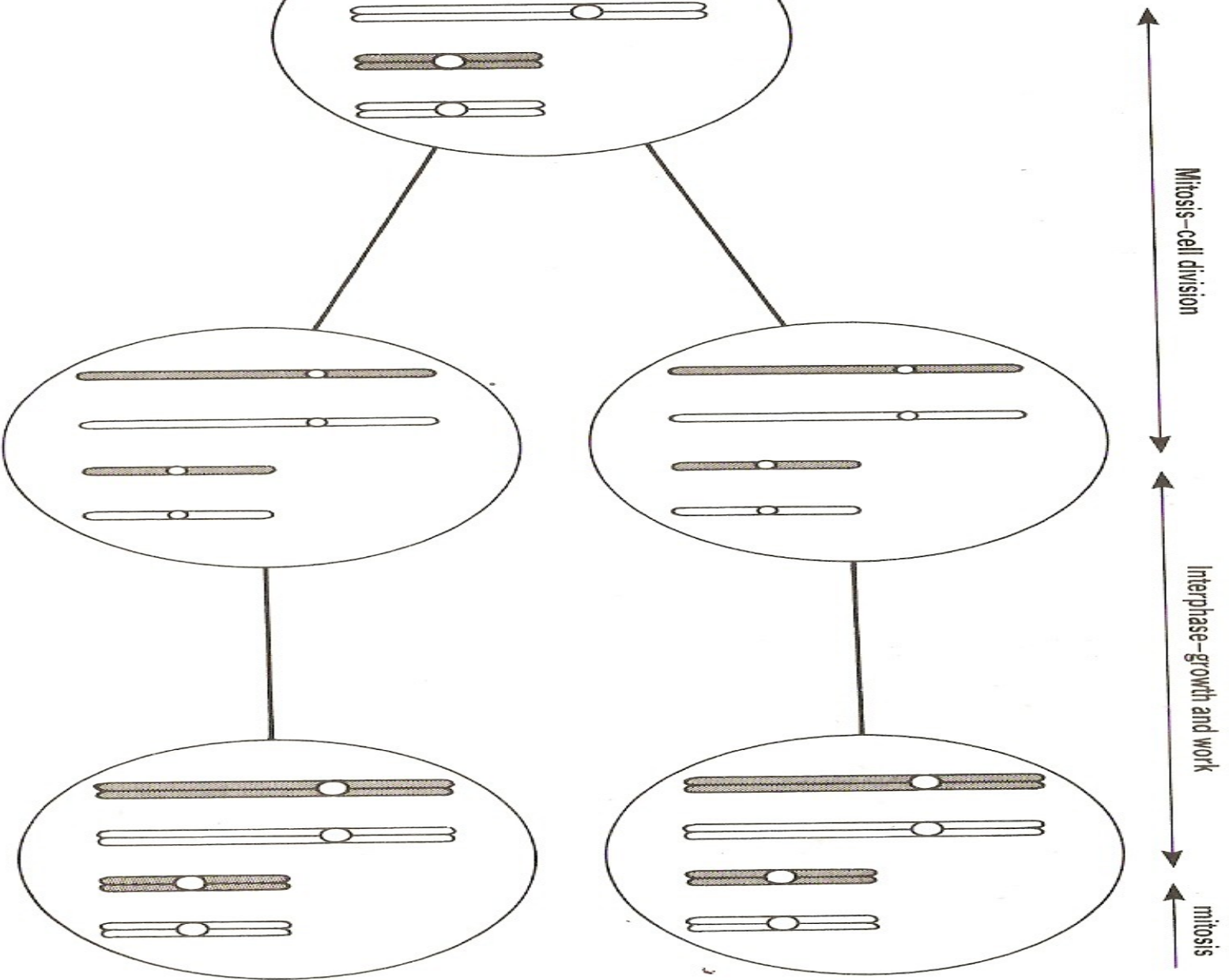
■ There are basically two types of cell divisions, namely;

1.Mitosis

2.Meiosis

# 1. MITOSIS

- This is a type of cell division in which the daughter cell nuclei have the same chromosomal constitution as the mother or the parental nucleus.
- It takes place in all body cells of an organism to bring about increase in the number of cells resulting in growth.
- It also occurs in a sexual reproduction.



parent cell contains four

During mitosis, each chromosome

During growth of the cell,

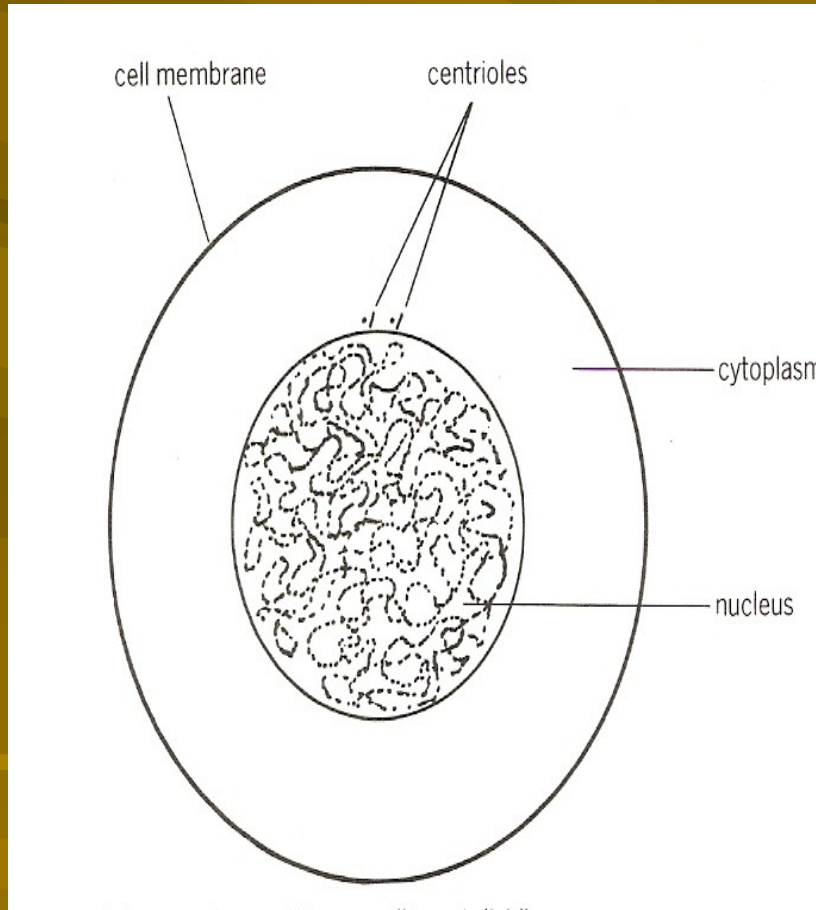
# Process of mitosis

- For convenience of discussion, mitosis is normally divided into four major stages.
- Prophase
- Metaphase
- Anaphase
- Telophase

NB: - Mitosis is a continuous process without any breaks between one stage and the next.

- Once the cell division is over the cell enters into a resting phase called the interphase in preparation for the next cell division.

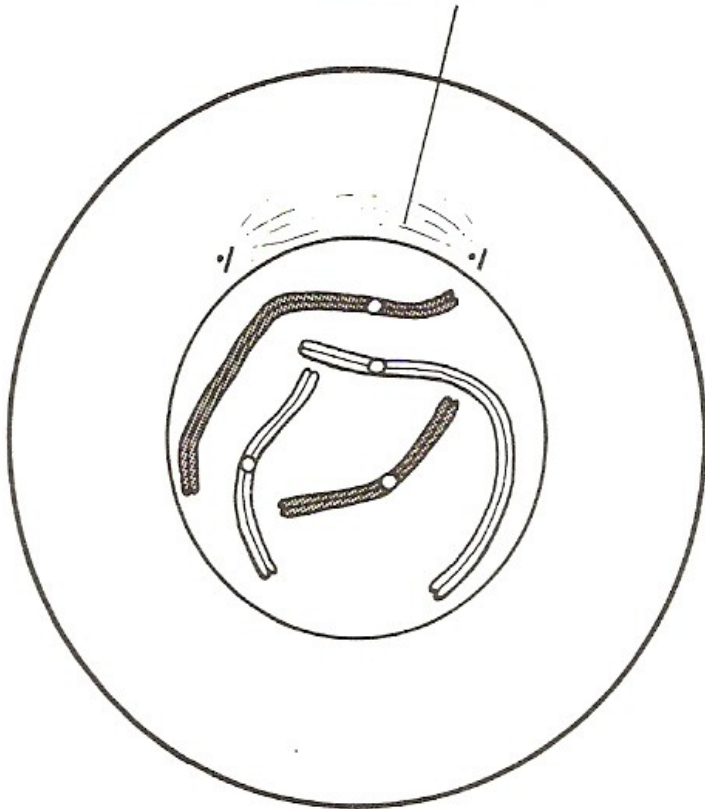
# Interphase



- **The cell undergoes internal reorganization in preparation for the cell division. These include;**
- **Chromosomal replication in which each chromosome produces an exact copy or replica of itself.**
- **Chromosomes are not visible as discrete structures; they appear as a diffuse tangle of threads known as the chromatin.**
- **Formation of new cellular organelles such as mitochondria, centrioles, ribosomes, golgi apparatus.**
- **Build up of enough energy store ( ATP ) which is needed to drive the mitotic process.**

# 1. PROPHASE

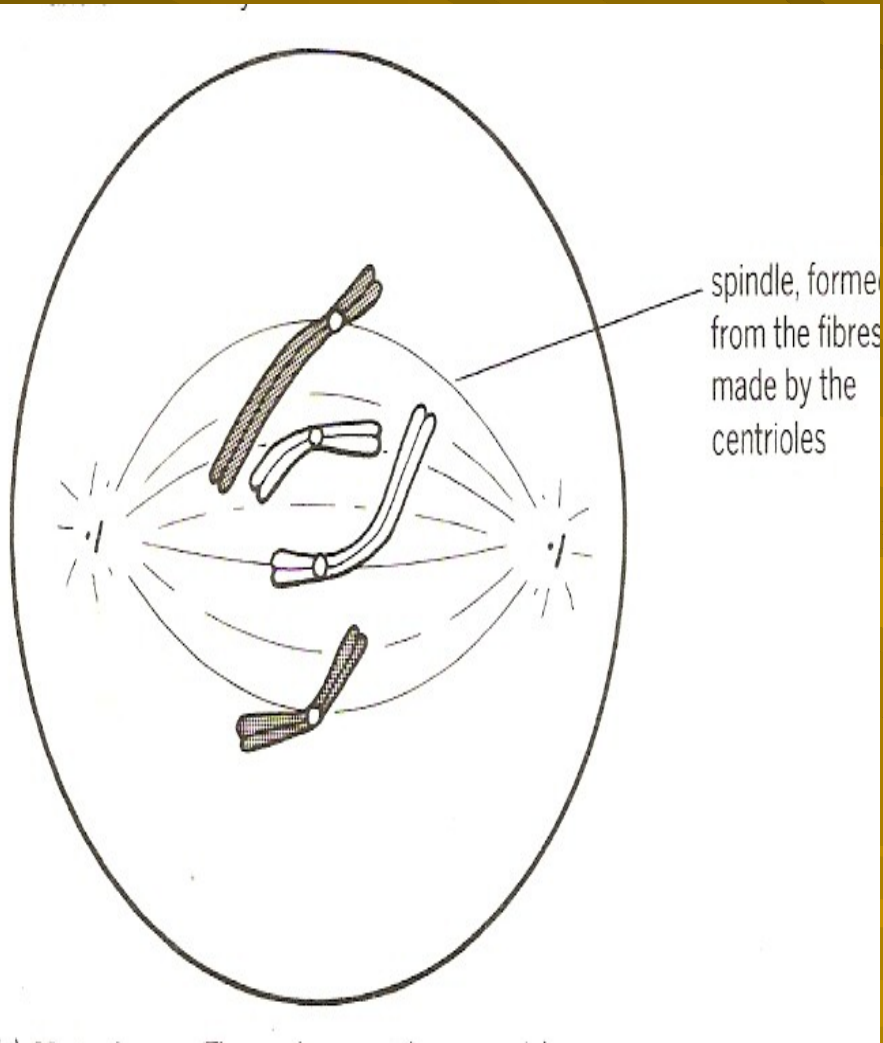
centrioles separate, forming  
fibres between them



(b) **Prophase** The chromosomes get short and

- **The chromosomes shorten and thicken and can take up dyes easily.**
- **The chromosome divides into two along its length forming two parallel strands called chromatids joined together at the centromere.**
- **The centriole divides into two, separate to opposite poles of the cell forming a spindle**
- **The nuclear membrane begins to break down while the nucleolus**

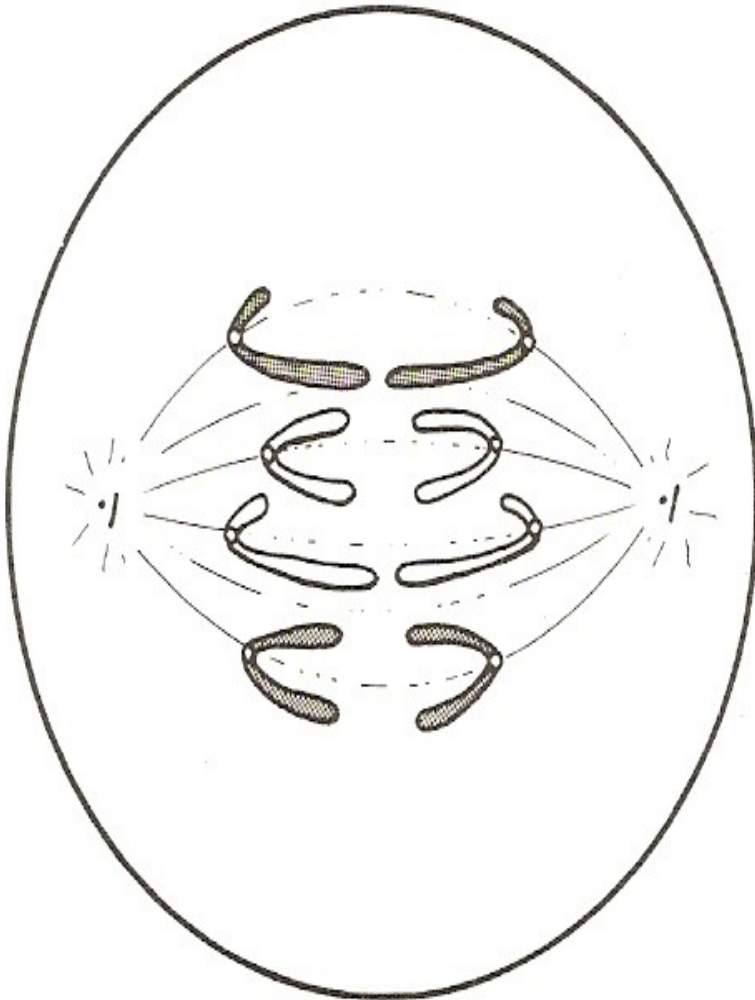
## 2. Metaphase



- **The nuclear membrane disappears.**
- **The spindle fibre lengthens.**
- **The chromosomes migrate to the centre of the cell and align themselves along the equatorial plane of the spindle.**
- **Each chromosome is attached to the spindle at the centromere.**

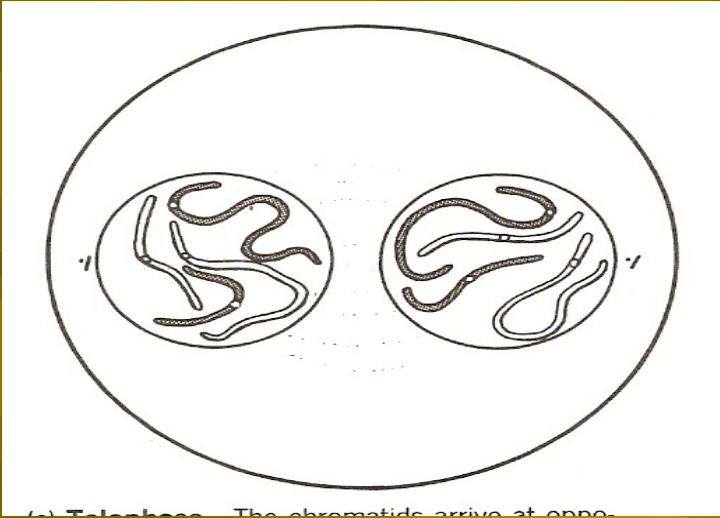
**NB: -Homologous chromosomes do not associate in any way.**  
**- Each chromosome acts independently.**

# 3. Anaphase

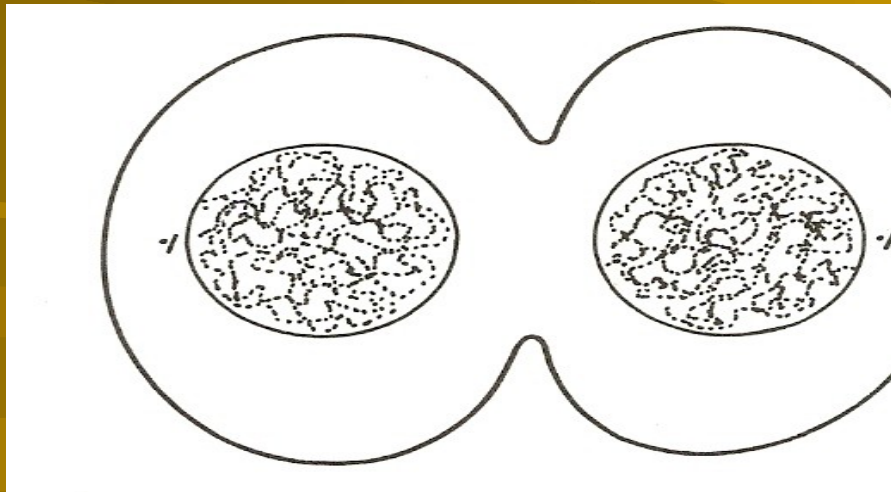


- The sister chromatids separate at the centromere and migrate to the opposite poles.
- This occurs as a result of contraction of the spindle fibres.
- The movement starts from the centromere with the result that the chromatids assume a 'V' shape with the points of the 'V' directed to the poles.
- The spindle fibre apparatus begins to disappear.

# 4. Telophase



(c) Telophase. The chromatids arrive at opposite poles.



- The chromosomes reach the opposite poles .
- The spindle fibre disappear
- The nuclear membrane forms round each set of chromatids and are now destined to become the chromosomes of the new daughter cell.
- The chromosomes become less distinct.
- The cytoplasm divides into two leading to the formation of two daughter cells.
- Cell membrane divides to envelop the two cells

# Significance of mitosis in living organism

- The conservation of the parental number of chromosomes. This ensures that all descendants of a single cell have the same genetic potential as the parent cell.
- Enables the multiplication of unicellular organisms like bacteria and amoeba.
- Mitosis gives rise to the new cells involved in the growth of a zygote or a vegetative part to adult organism and repair of worn out tissues.

# MEIOSIS

- Meiosis is a type of cell division that takes place in the reproductive organs (gonads) to produce gametes both in plants and animals.
- This process results to the gametes having half the number of chromosomes that in the mother cell.( haploid number)

# PRINCIPLE UNDERLYING MEIOSIS

- Meiosis consists of two successive cell divisions designated as:

MEIOSIS I

MEIOSIS II

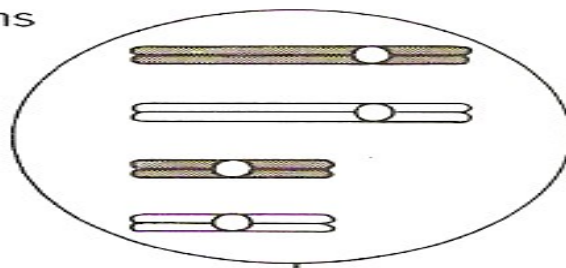
# MEIOSIS I

- **The number of chromosomes is reduced by one half.**
- **For this reason it is called the reduction phase or reduction division**
- **The homologous chromosomes get separated from each other and go into different cells.**

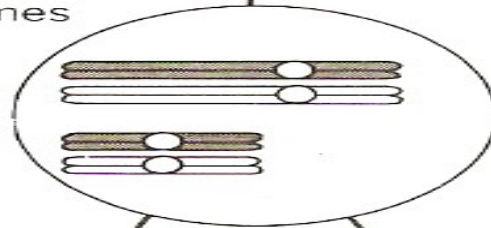
# MEIOSIS II

- **Results in the separation of the sister chromatids.**
- **For this reason its called the equatorial division.**

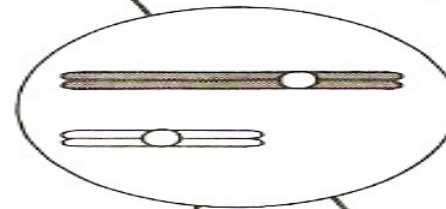
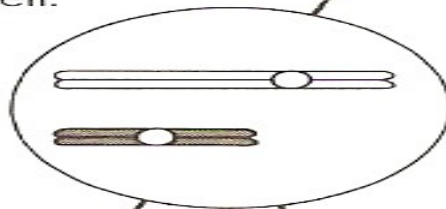
The parent cell contains four chromosomes.



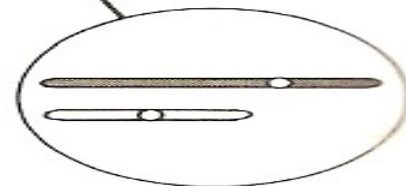
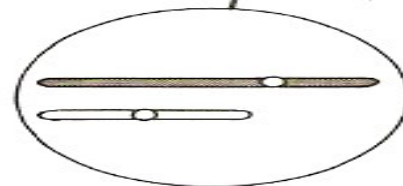
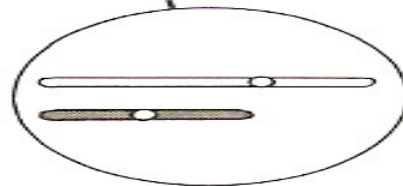
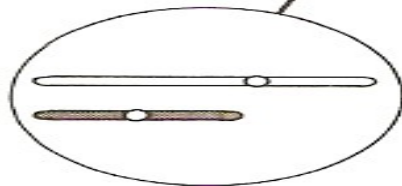
Homologous chromosomes pair together.



Homologous chromosomes separate, one from each pair going into each daughter cell.



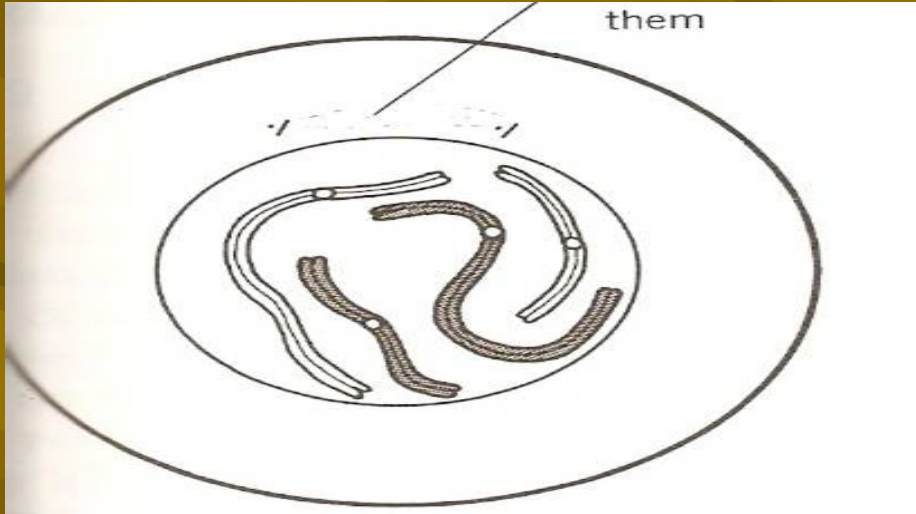
Each chromosome separates into two chromatids, one of each kind going into each daughter cell.



# The process of meiosis

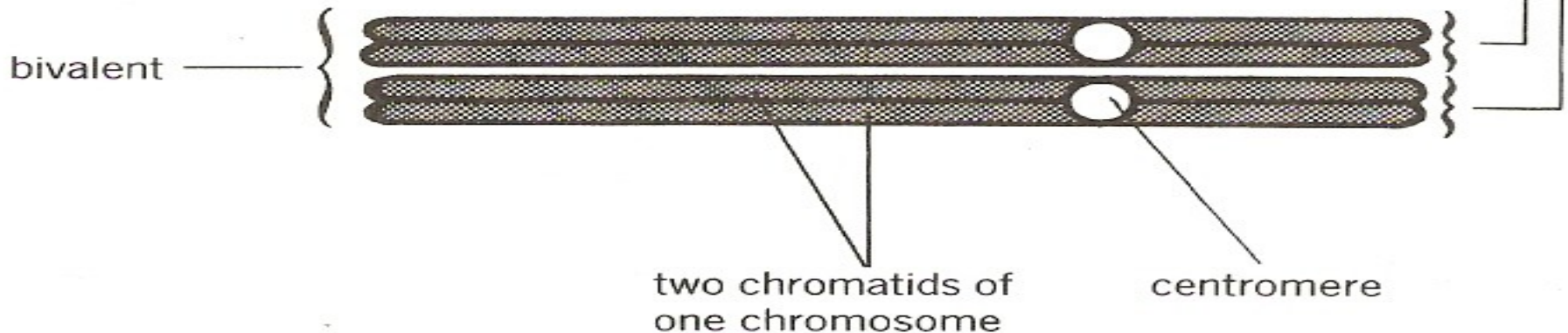
- Each of the two meiotic divisions is divided for convenience into prophase, metaphase, anaphase and Telophase.
- Each stage is followed by I or II indicating whether it belongs to meiosis I or Meiosis II.

# Meiosis I

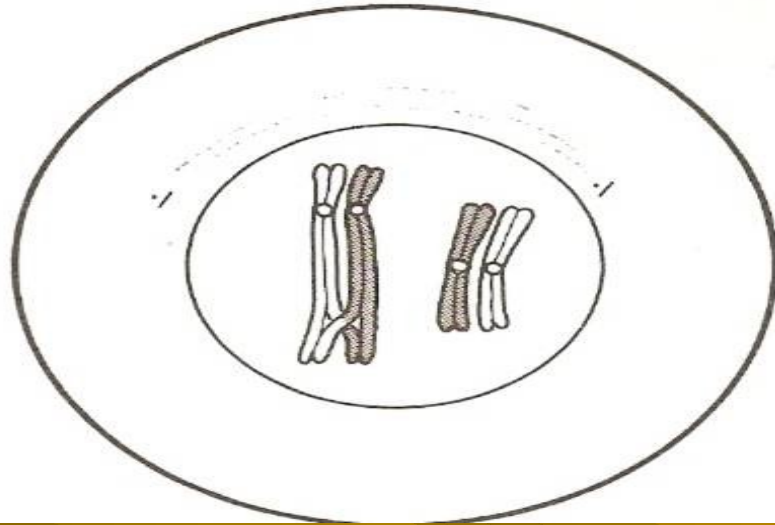


**Early prophase  
I  
Chromosomes  
shorten and  
thicken.**

two chromosomes of the same  
kind, called homologous chromosomes



# Late prophase I

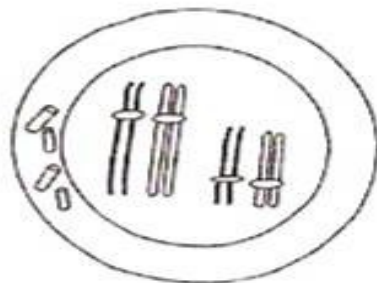
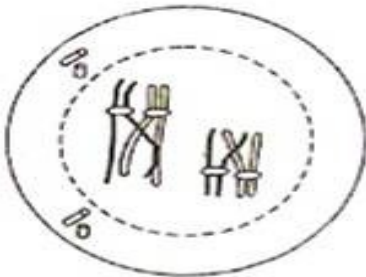


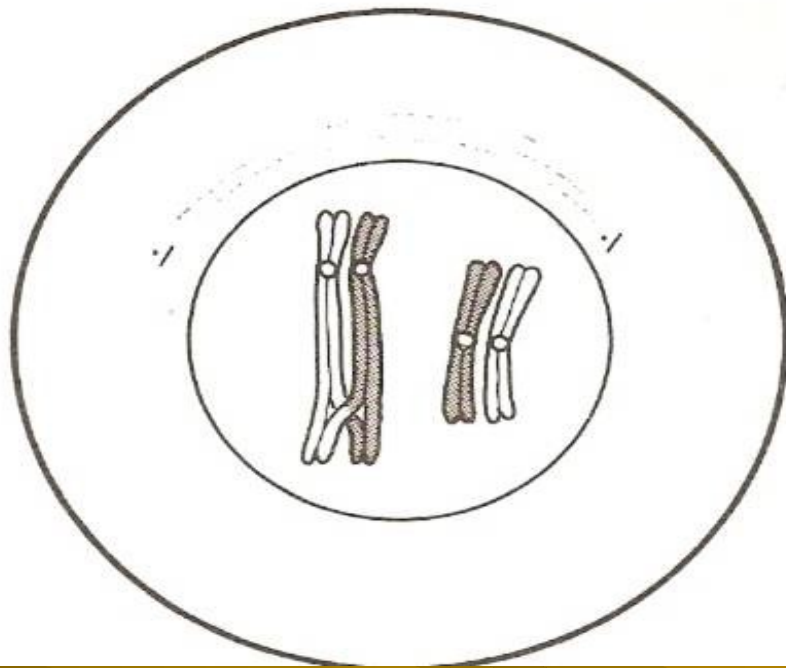
- Homologous chromosomes pair and lie side by side intimately. This process is called synapsis.

- Each pair is called a bivalent .

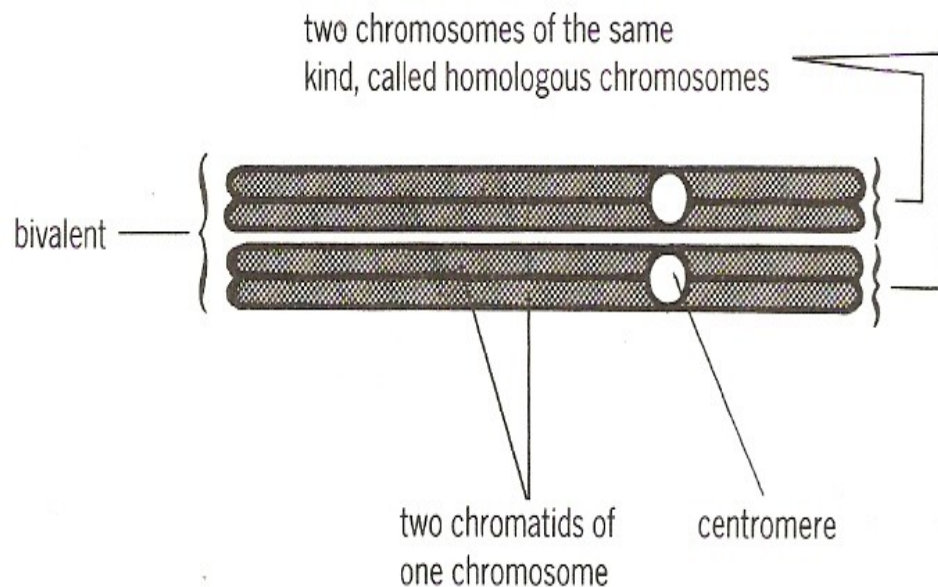
- Each chromosome splits into two

**Prophase I**



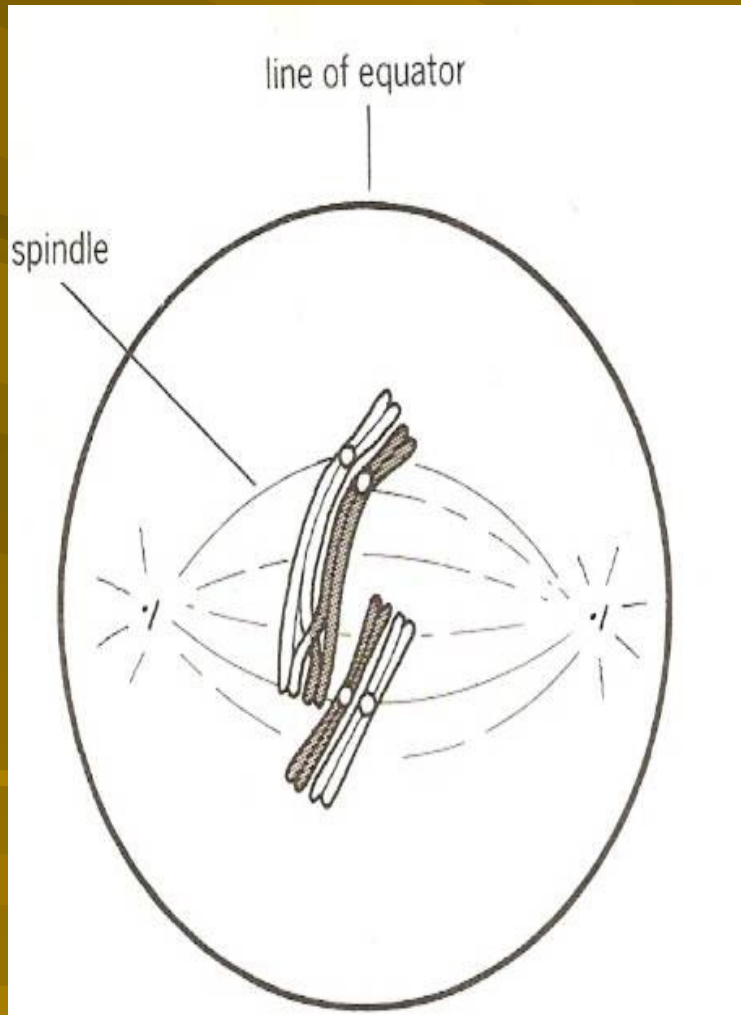


■ The contact between the bivalent loosens and the chromosome moves away from each other. However they still retain contact at certain points known as chiasmata



■ The chromatids of the bivalent are seen to have crossed over each other at the chiasmata. During this cross over, exchange of chromatid portion

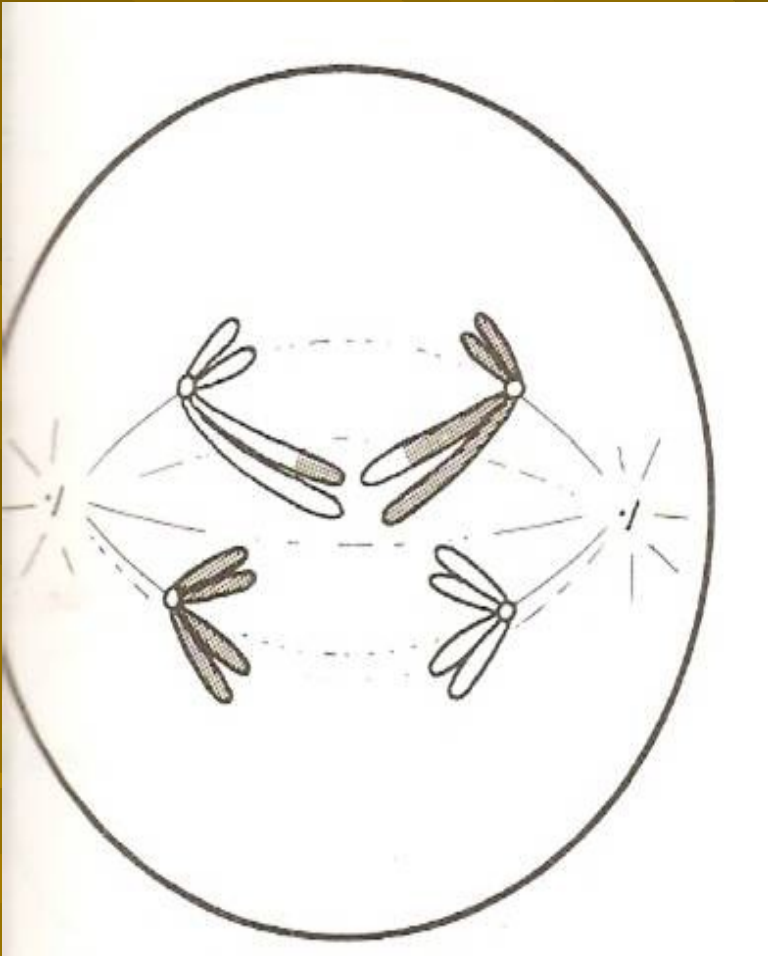
# Metaphase I



- The spindle fibres are formed and attached at the centromere
- The bivalent move to the equator of the spindle. Bivalents do this as a unit.
- Sister chromatids orient towards the same pole
- Homologous chromosomes orient towards the opposite poles

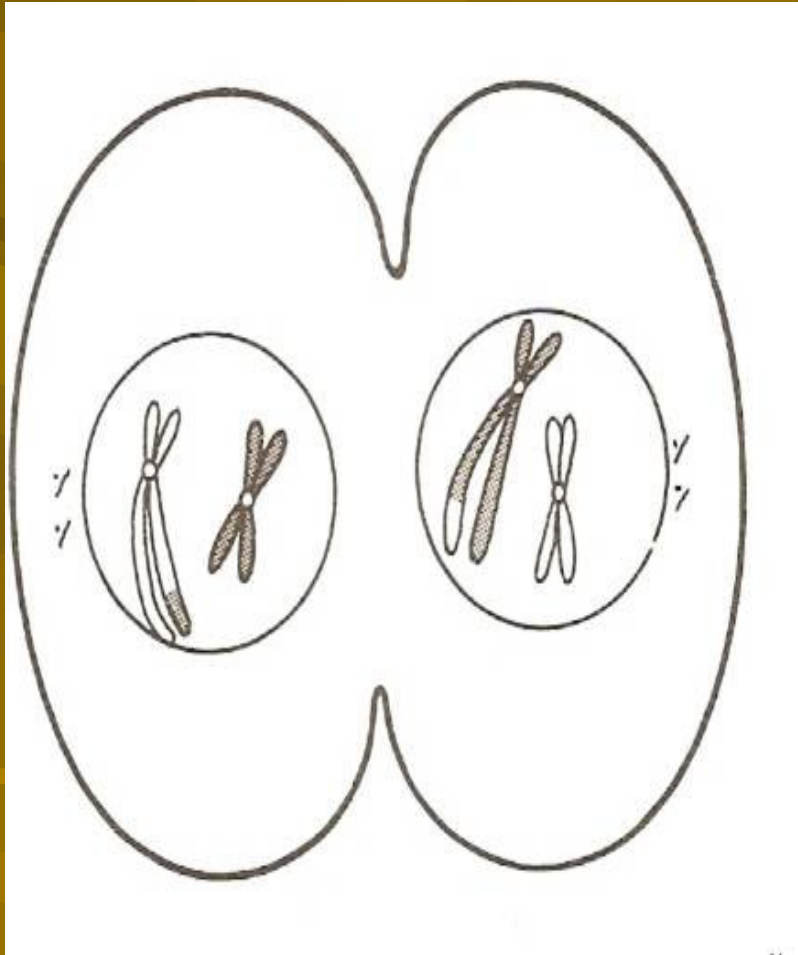
(This positioning is

# Anaphase I



- The homologous chromosomes separate from each other and migrate towards the opposite side poles.
- The sister chromatids no longer remain in parallel alignment but diverge from one another
- Note that the sister chromatids do not separate at this stage

# TELOPHASE I

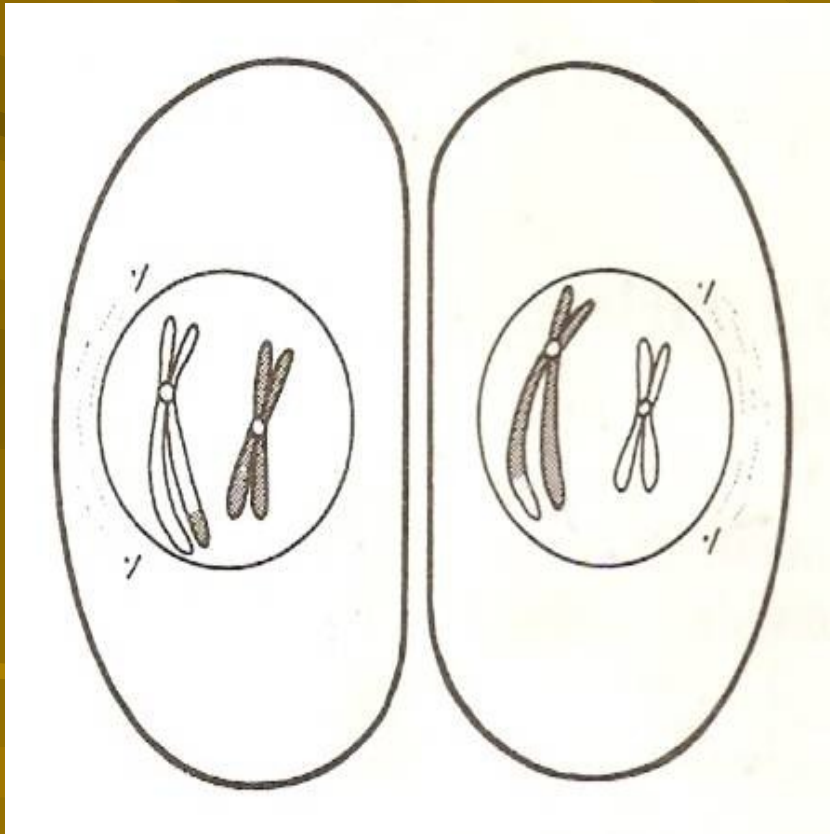


- Once the chromosomes reach the poles, they become densely packed together.
- The spindle apparatus breaks down.
- Nuclear membrane is formed around each set of chromosomes
- The cell then divides into two like in mitosis.
- Daughter cells may undergo a short interphase before proceeding to meiosis II
- At the end of meiosis I separation of homologous chromosomes is achieved.

# MEIOSIS II

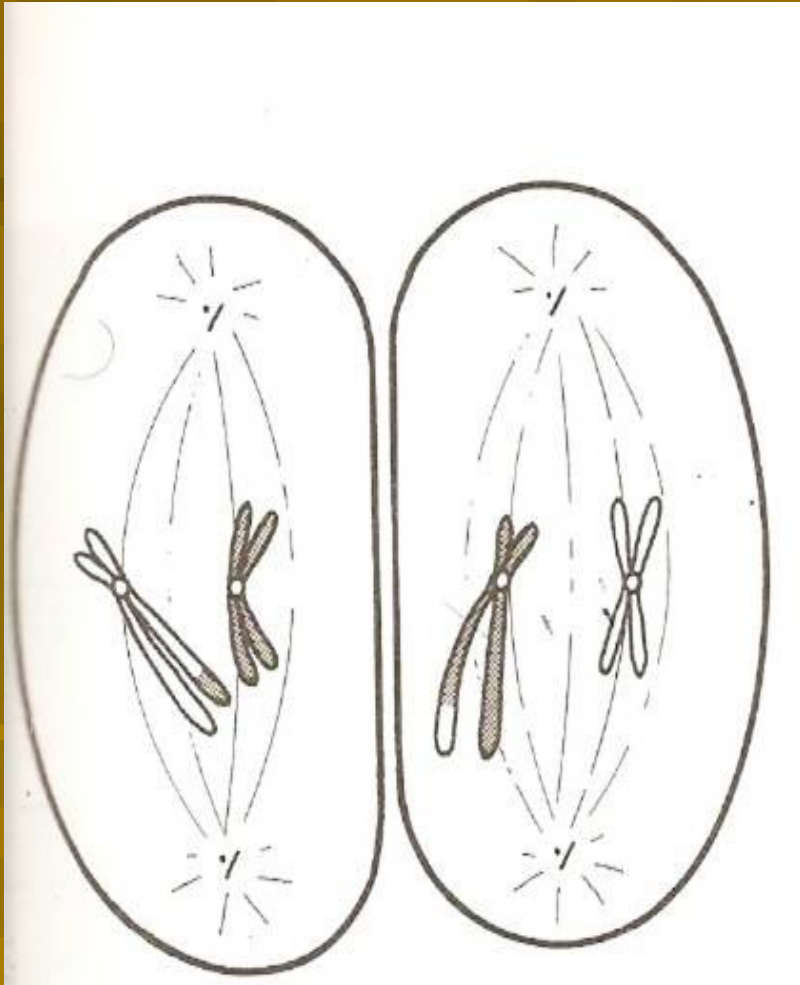
- **Aims at separating the chromatids from each other**

# PROPHASE II



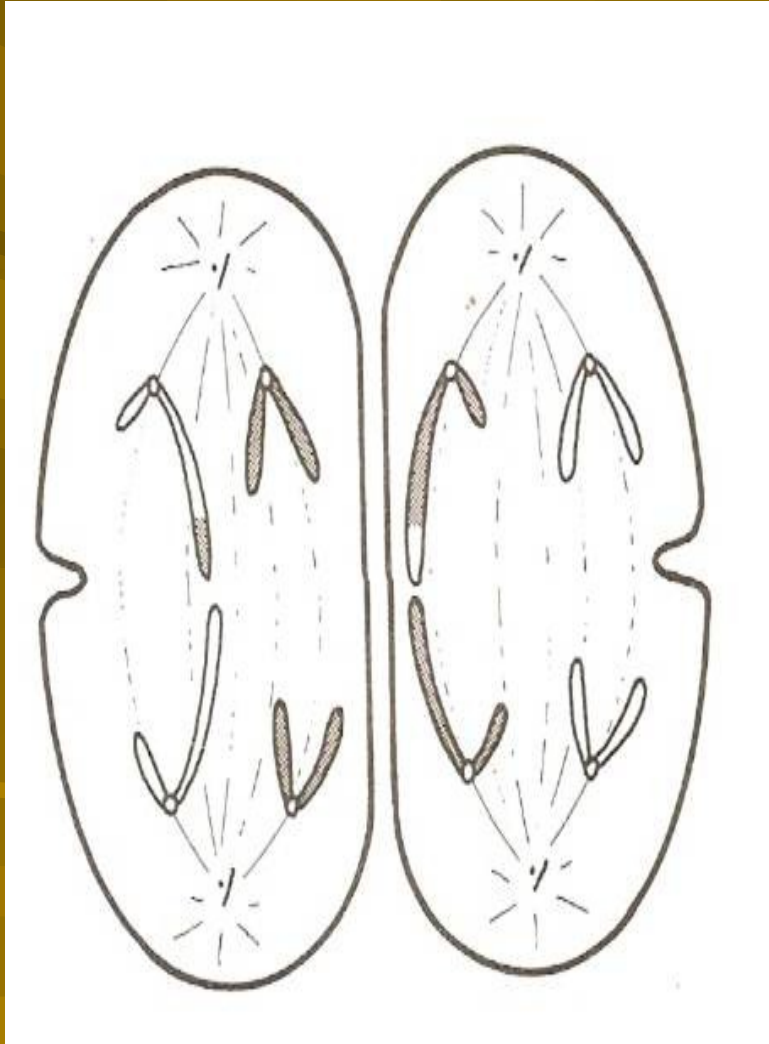
- **Chromosomes become shorter and thicker**
- **A new spindle fibre is formed**

# METAPHASE II



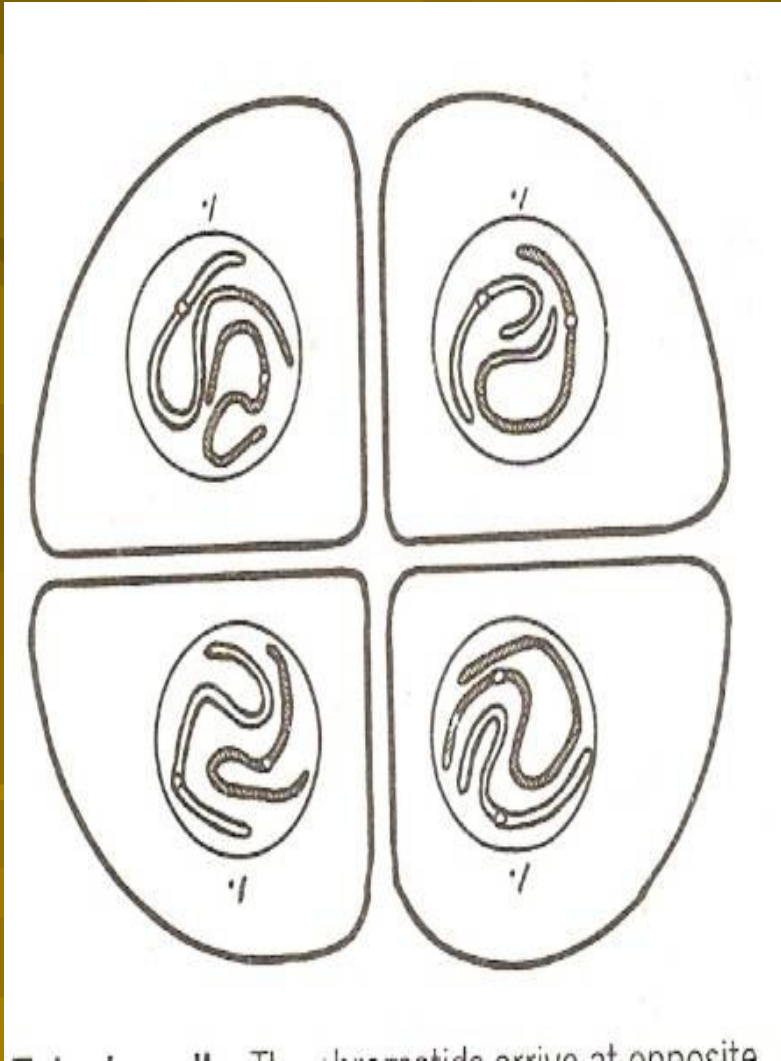
- **Chromosomes migrate to the center of the cell (equator of the spindle)**
- **Spindle attach to the chromatids**

# ANAPHASE II



- **Sister chromatids separate and move towards the opposite poles**
- **The chromatids become the chromosomes of the daughter cells**

# TELOPHASE II



- Spindle apparatus disappears
- A new nuclear membrane is formed around each set of chromatids
- The chromatids (chromosomes) uncoil and regain their thread like form
- The cell divides into two. Thus meiosis results in four daughter (tetrad) cells each with

# SIGNIFICANCE OF MEIOSIS

- Occurs in the formation of gametes like eggs or sperms each with half the n<sub>o</sub> of chromosomes present in the parent cell on all organisms carrying out sexual reproduction. During fertilization, the haploid sperm fuses with the haploid egg to form a diploid zygote. Through mitosis, the zygote undergoes cell multiplication eventually forming an adult organism with trillion of diploid cells
- If the n<sub>o</sub> of chromosomes was not halved during gamete formation, there would have been doubling of chromosomes for each successive sexually reproduced generations. Hence meiosis helps to restore a constant diploid chromosomal constitution in a

- **Meiosis provides opportunities for new combination of genes to occur in the gamete cells leading to genetic variation in the genotype and phenotype of the offsprings produced by gamete fusion**

# **SIMILARITIES BETWEEN MITOSIS AND MEIOSIS**

- **Both take place in plants and animals**
- **Both involve the division (multiplication) of cells**

# DIFFERENCES

## MEIOSIS

- Takes place in two phases each having four stages; prophase, metaphase, anaphase, Telophase.
- Occurs in sex cells leading to gamete formation.
- Homologous chromosomes associate.
- Chiasma formation takes place and may lead to crossing over hence variation
- Produces four daughter cells, each

## MITOSIS

- Takes place in one phase of four stages; prophase, metaphase, anaphase and Telophase.
- Occurs in somatic cells leading to growth.
- Homologous chromosomes do not come together
- Crossing over does not take place
- Produces two daughter cells each diploid.

# STUDY QUESTION 1

**a) Explain the significance of mitosis in the life cycle of an organism. 6 mks**

**b) Name two parts in a plant where mitosis occurs and name the cells that are formed**

**4 mks**

**c) Name two parts in an animal where mitosis occurs and name**

## Study question 2

- a) Explain the significance of meiosis in the life cycle of an organism. 6 mks**
- b) Name two parts in a plant where meiosis occurs and name the cells that are formed**

**4 mks**

- c) Name two parts in an animal where meiosis occurs and name**

# Study question 3

**Tabulate the difference between  
mitosis and meiosis  
8 mks**

# Asexual reproduction

- In asexual reproduction one or more new freely existing organism arise from a single parent without fertilization.
- The offspring arising from this kind of reproduction have the same genetic constitution as the parent (hence refers to as a clone) except in rare cases where mutation occur.
- It can be classified into several categories
  - Fission
  - Spore formation
  - Budding
  - Vegetative reproduction

# Fission

- It is also referred to as splitting fission splitting.
- It is the process by which a single celled organism divides into two or more roughly or equal parts
- It can be further classified as binary, multiple fission.

# Binary fission

- The parent cell divides into two daughter cells that grow into freely existing individual cells.
- The fission occurs when the organism attains maximum size
- The process involves ;
  - Internal reorganization.
  - Division of nucleus (karyogamy)
  - Cytoplasmic division (cytogamy)
  - It is common in bacteria, algae, some protozoa, amoeba, paramecium and trypanosomes.

# Binary fission in amoeba

- It is possible when conditions are favorable;
  - Enough food.
  - Favorable temperature
  - PH within tolerable limits
- First step is the molecular division -internal reorganization of molecules necessary for structural construction.
- Molecules are re-aggregated and utilized in the formation of the new cells.
- Followed by nucleus division -the nucleus division, mitotic division to give rise to two nucleus with haploid number of chromosomes.
- the cytoplasm then divides into two daughter cells which separate from each other.

# Diagrammatic representation of binary fission

- **The daughter amoeba - the product of binary fission .**
- **The rate of binary fission may be very fast e.g. Under favorable conditions.**

# Multiple fission

- The nucleus divides into repeatedly through mitosis into many small nuclei;
- Each daughter cell breaks away with small amount of cytoplasm to form a freely existing individual cell .
- It is common in malaria parasite vivax

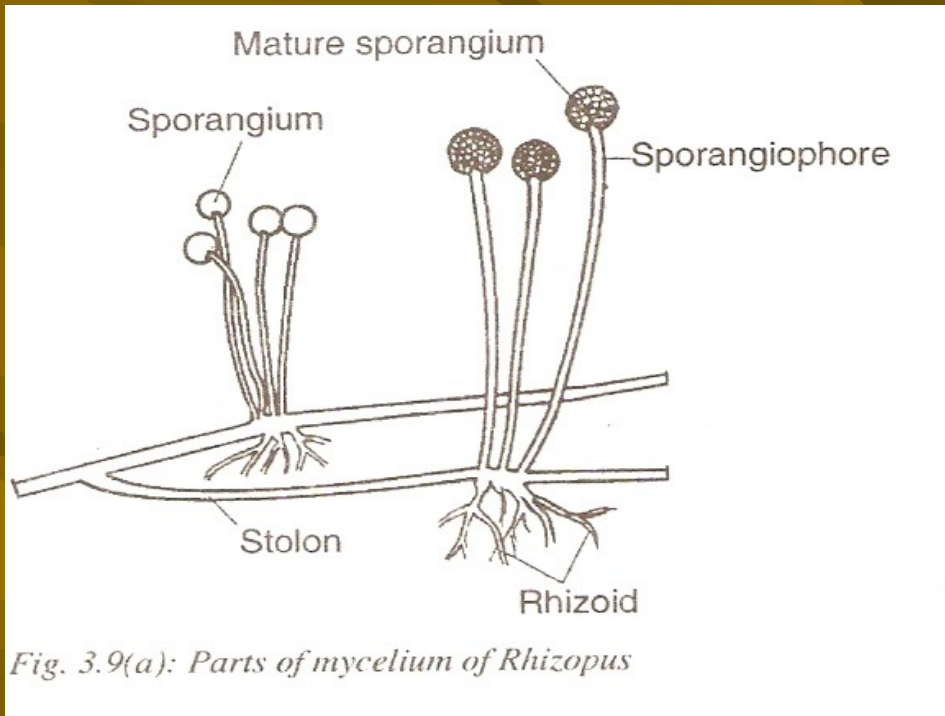
# Spore formation (sporulation)

- Spores are haploid bodies produced by algae, fungi, liverworts, mosses and ferns.
- They are unicellular, microscopic with a nucleus and small amounts of cytoplasm.
- They are produced in large numbers and are light for easy dispersal by air currents.
- When a spore lands on a suitable substrate, it germinates and gives rise to a new individual.

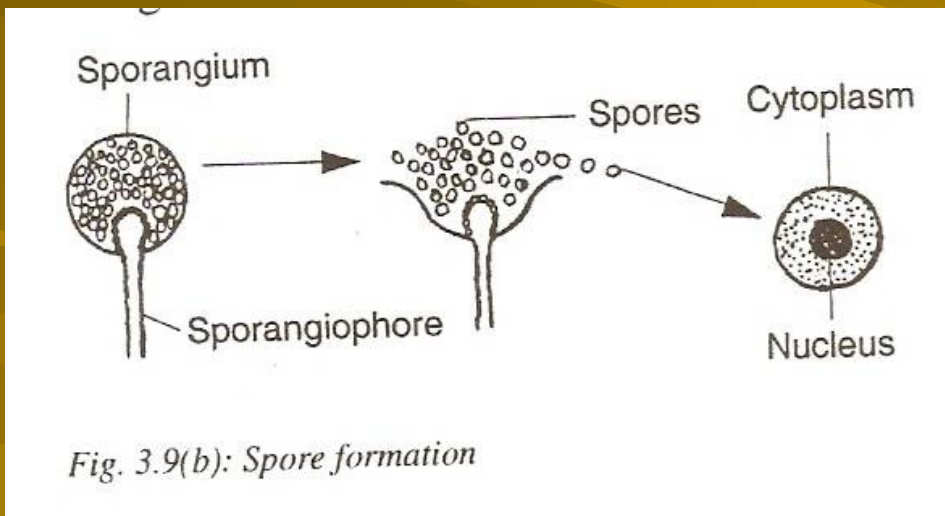
# Spore formation in Rhizopus

- Rhizopus is a saprophytic fungus which grows on substrate like bread rotting fruits and other decaying matter
- The vegetative body is called mycelium which consist of many branched threads called hyphae.
- The hyphae that grows vertically are referred to as sporangiosphore.
- The tips of these hyphae swell up to form the sporangium (spore bearing structure).

- In this case the asexual reproduction occurs when the conditions are favorable.
- Under such conditions, the vegetative part, mycelium (diploid) forms aerial hyphae called sporangiosphore which grows in an upright position.
- At the tips of the sporangiosphore club shaped swelling develops called the sporangium.
- Inside the nucleus, the nucleus divides meiotically producing daughter nuclei that contain a haploid number of chromosomes.
- Daughter nuclei develop into



- **Sporangium contains spores.**
- **As it matures and ripens, it turns black in colour.**
- **As it matures the sporangium wall bursts and release **spores** which are dispersed by wind, insects or scattered by animals to restart afresh generation of growth and development.**



# Budding in yeast

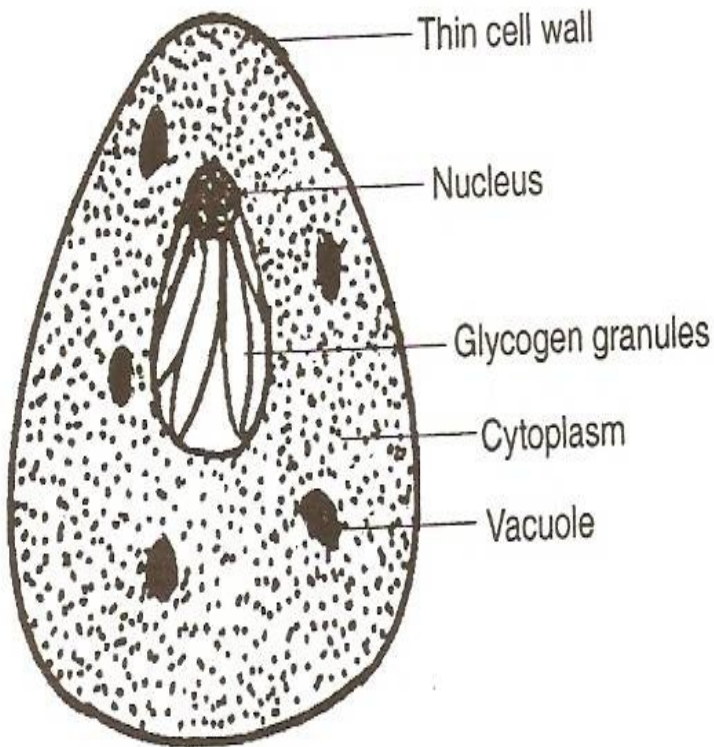
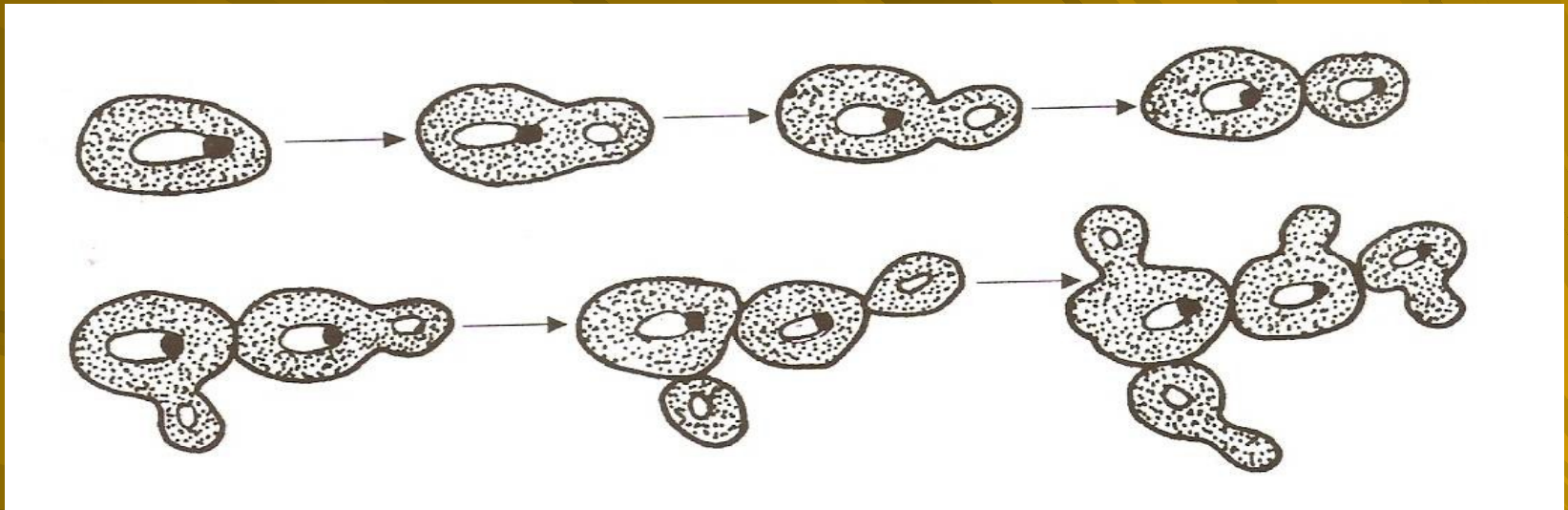


Fig. 3.10(a): Structure of yeast cell

- Yeast- A single celled fungus
  - Belongs to Mycophyta division
- Structure**
- Has a thin cell wall which encloses the cytoplasm contents, vacuoles and nucleus.
  - Cytoplasm contains glycogen granules and other food reserves
  - Yeast cells reproduce asexually when condition are favourable by budding .
  - Conditions include; plenty of sugar, oxygen, moisture, optimum temperature.

# Stages/process of budding



- A small area of the cell wall of a parent cell softens and forms a projection of bud.
- The bud bulges outwards.
- The nucleus divides into two, one of the nucleus moves into the new bud.
- The bud grows in size and forms new organelles.
- The bud separates off, but because the budding process is very fast, the first bud begins to form another bud before it separates off from the parent thus forming a chain of cells.

# Practical activity: To observe budding in yeast cells

## Requirements

- Baker's yeast.
- 10% sugar solution
- microscope
- microscope slides
- cover slips
- droppers
- methylene blue and beaker

## Procedure

- Put some yeast in the beaker containing 10% sugar solution.
- After two hour take a drop of the suspension, place it on a microscope slide and cover with a cover slip.
- Stain with methylene blue. Drain off excess stain using a filter paper.
- Examine the preparation under low power of the microscope to identify the budding yeast cells.
- Draw and label the budding yeast cells.

# question

A student left a damp piece of bread on an open plate accidentally. Three days later he observed some black substance developing . Explain how black substance was formed.

# Advantages of asexual reproduction

- The offspring resemble the parent from which they were produced hence the parental characteristics are maintained without variation. Hence its possible to obtain a particular kind of organism with some special desired quality.
- The new plants produced by asexual reproduction mature faster as compared to those produced by sexual production.
- Asexual reproduction doesn't rely on pollination, fertilization and dispersal of fruits and seeds. Hence the plants depends on its own activity to reproduce asexually.
- The new plants are able to survive temporarily unsuitable condition in that they still obtain nourishment from their parent plants.
- No wastage of offsprings since asexual reproduction gives rise to dense clumps of plants

## Disadvantages of asexual reproduction

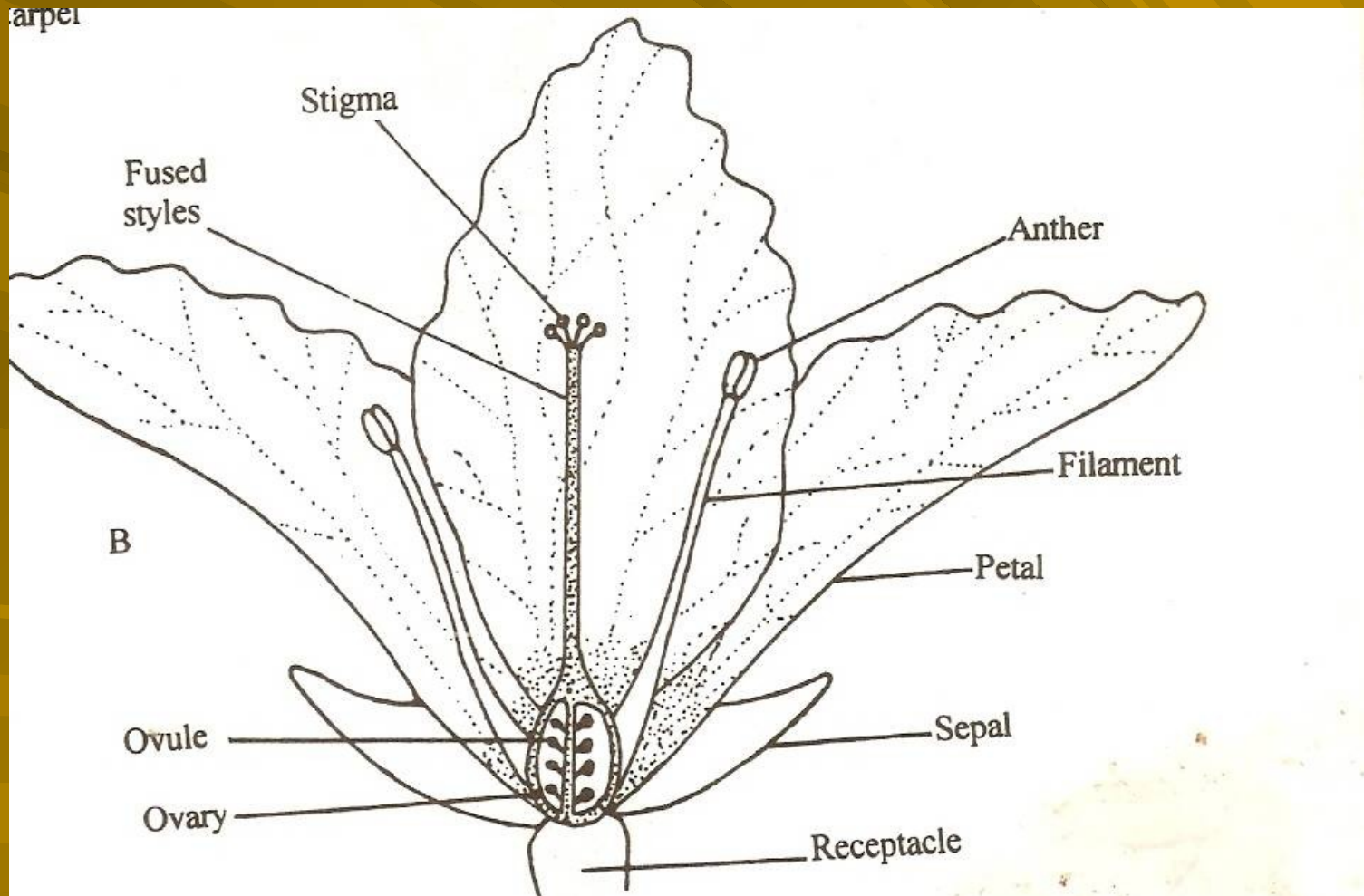
- Asexual reproduction gradually reduces the strength and vigour of the succeeding generation.
- Since there's no variation, the offsprings may not be able to withstand the changing environmental conditions.
- The new offsprings being exactly similar to the parent, would carry even undesired qualities and certain diseases from the parent.
- Due to the fast growth of the offsprings, asexual reproduction thus could lead to overcrowding and offspring competition of which only a few member will survive.

# SEXUAL REPRODUCTION IN PLANTS

- In plants sexual reproduction is done by the flower.
- The flower develops from the main stem or side branch with which it is attached through a flower stalk or pedicel.
- After pollination, followed by fertilization, the ovary of the flower forms the fruits which encloses the seeds which can later germinate to give rise to a new plant.

# Structure and function of the flower

**Longitudinal section of a generalized dicotyledonous flower.**



# Parts of a flower

- **Typically there are four whorls [groups of floral structures] attached to the receptacle i.e.**
  - **Calyx**
  - ▢ **Corolla**
  - ▢ **Androecium / male parts**
  - ▢ **Gynaecium / pistil / female parts**

- The flower stalk / pedicel attaches the flower to main stem or side branch of the plant.
- The tip of the pedicel is swollen to form a receptacle onto which the floral parts are attached.

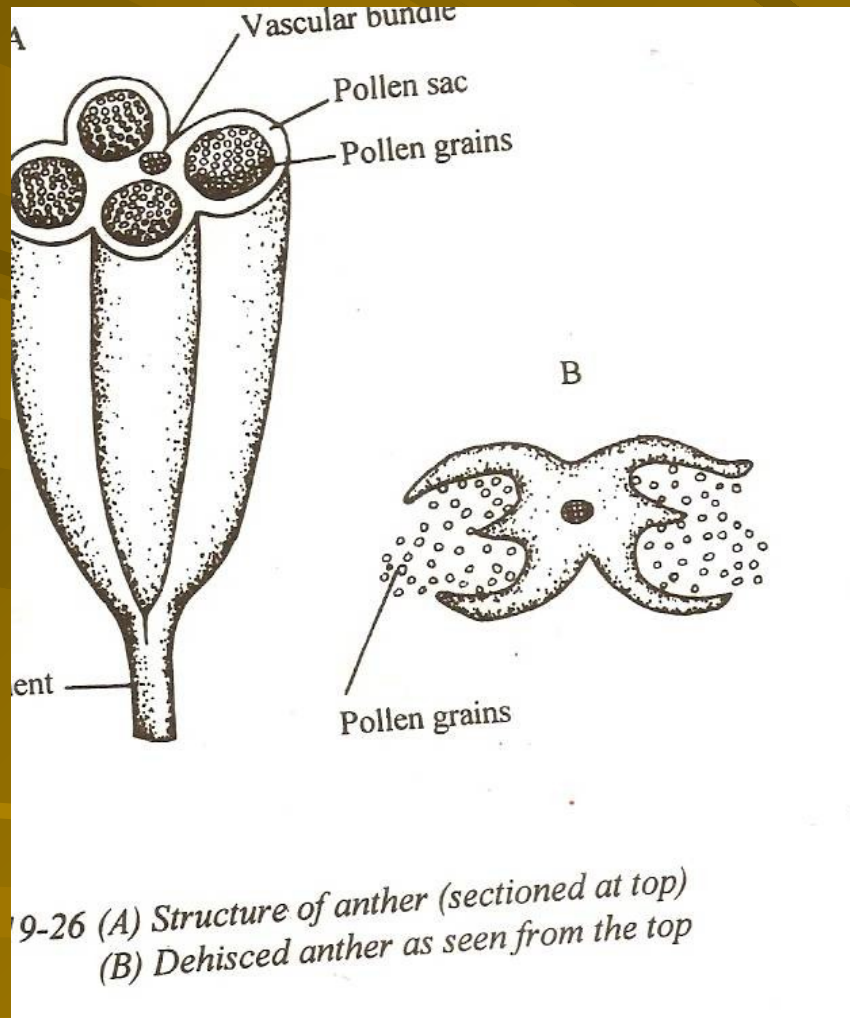
# THE CALYX

- The outer most whorl consist of the sepals that collectively form the calyx.
- The sepals are often green and leaf like.
- IT may be free I .e attached [polysepalous calyx] or fused condition ref as gamosepalous calyx.
- The/ sepals enclose and protect inner parts of the flower when it is in a bud.
- In some flowers, there may be another ring of sepal like structure just beneath the calyx called epicalyx.
- In few cases, the sepals may be large, white or brightly coloured as in cremates and cana Lily.

# THE PETALS

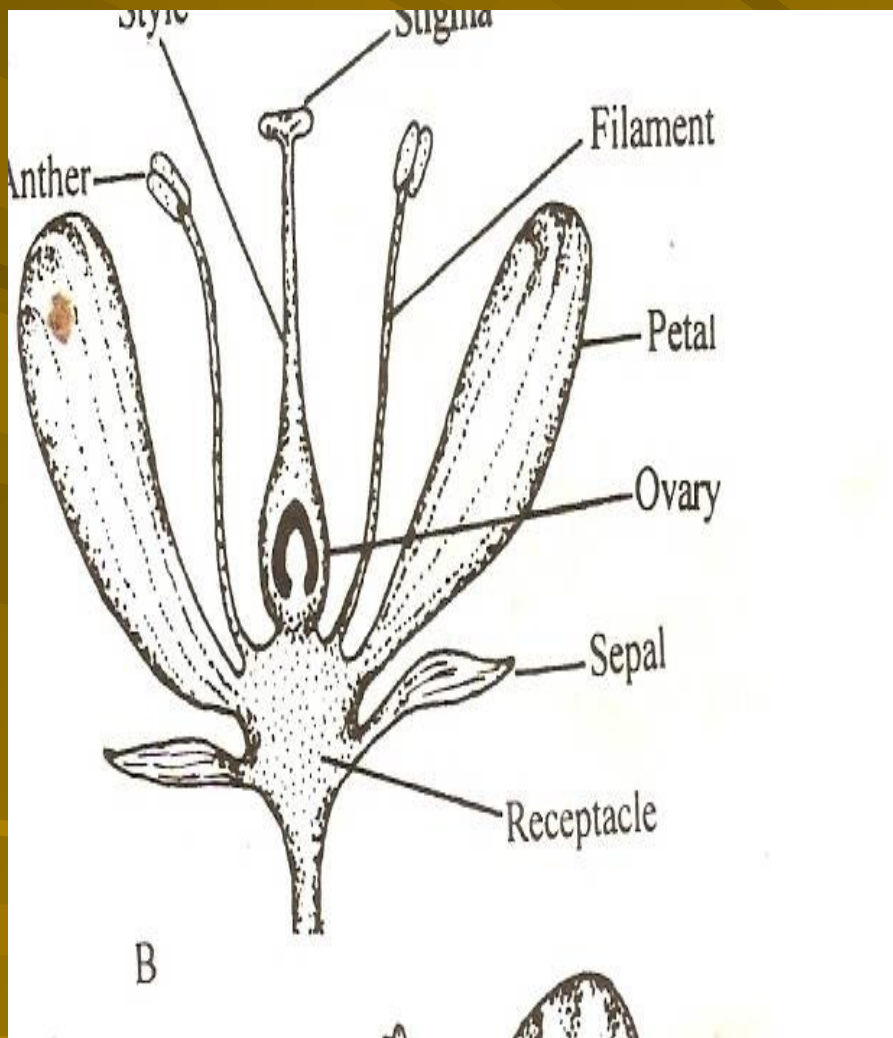
- Next to the calyx are the petals which collectively form the corolla.
- The corolla is;
  - Normally large, white or brightly coloured and sweetly scented.
  - Forms the beautifully noticeable parts of the flowers .
  - In most flowers , may have glandular swellings called nectaries at their base.
  - Nectaries; secrete a sugary fluid called nectar that serves the purpose or as a bait for pollinating insects.
  - If fused, the corolla is said to be gamopetalous, and if free it is described as polypetalous.
  - The sepals and petals together form what is called the **perianth**.

# Stamens



- Next to the corolla is one whorl or two whorls of filamentous or club shaped structures called the stamens.
- These form the Androecium or the male part of the flower.
- The stamens consist of two parts, the long stalk like structure, referred to as the filament which bears the anther at the top.
- The anther consist of four pollen sacs, which contain the pollen grain .
- The pollen grains form the male gamete.
- stamens may be fused forming a staminal tube e g hibiscus.

# Pistil



- ❑ The innermost whorl consist of one or more carpels forming the pistil or the female reproductive organs [gynoecium]
- ❑ Each carpel consists of three parts;
  - An expanded hollow base called the ovary which contains the ovules.
  - A slender stalk called the **style** which terminates into small swelling called the stigma

# Types of pistils

- There are three types of pistils depending on;
  - The number of carpels
  - The degree of fusion of the carpels
- Monocarpous pistil
- Syncarpous
- Apocarpous pistil

# A) Monocarpous pistil

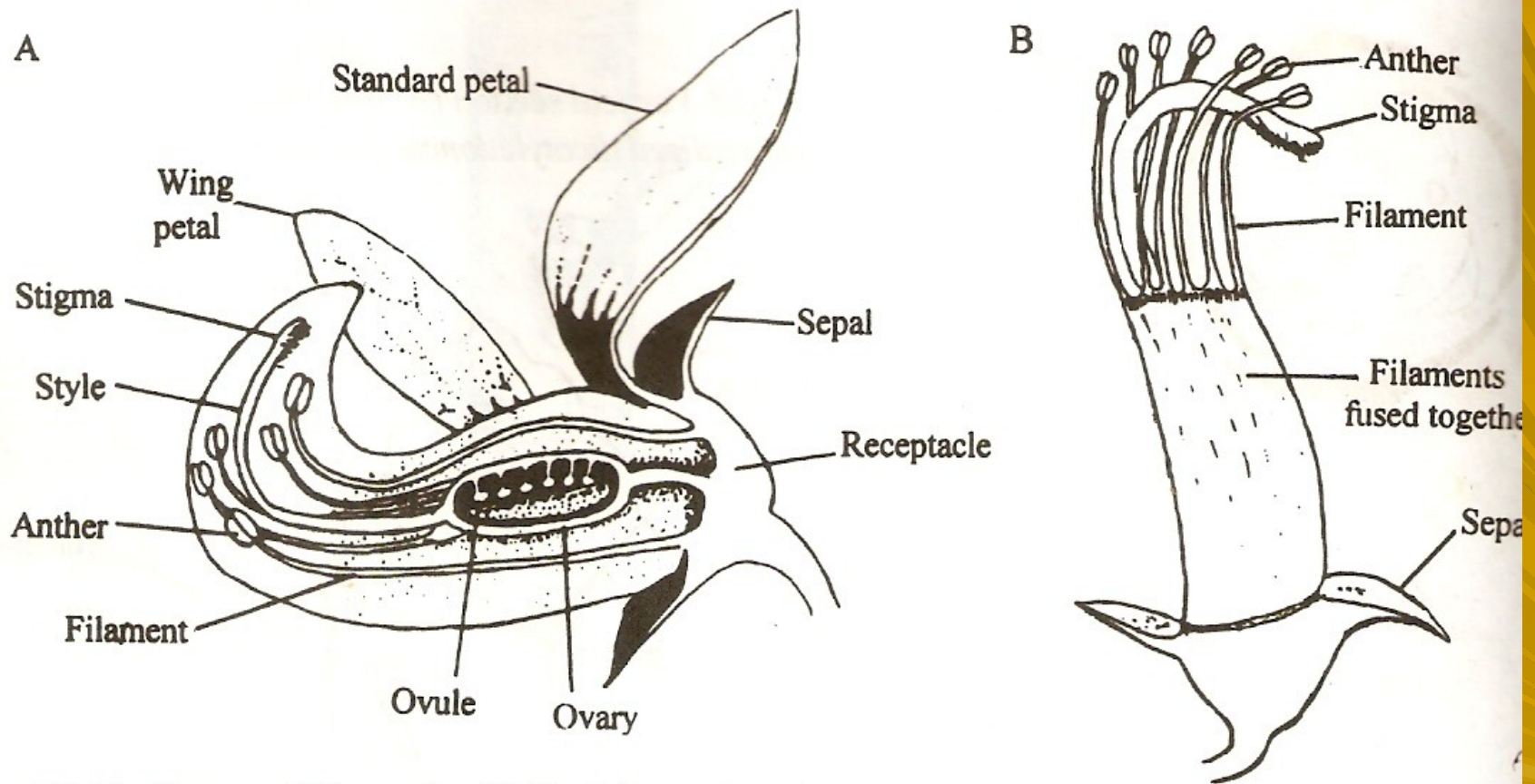
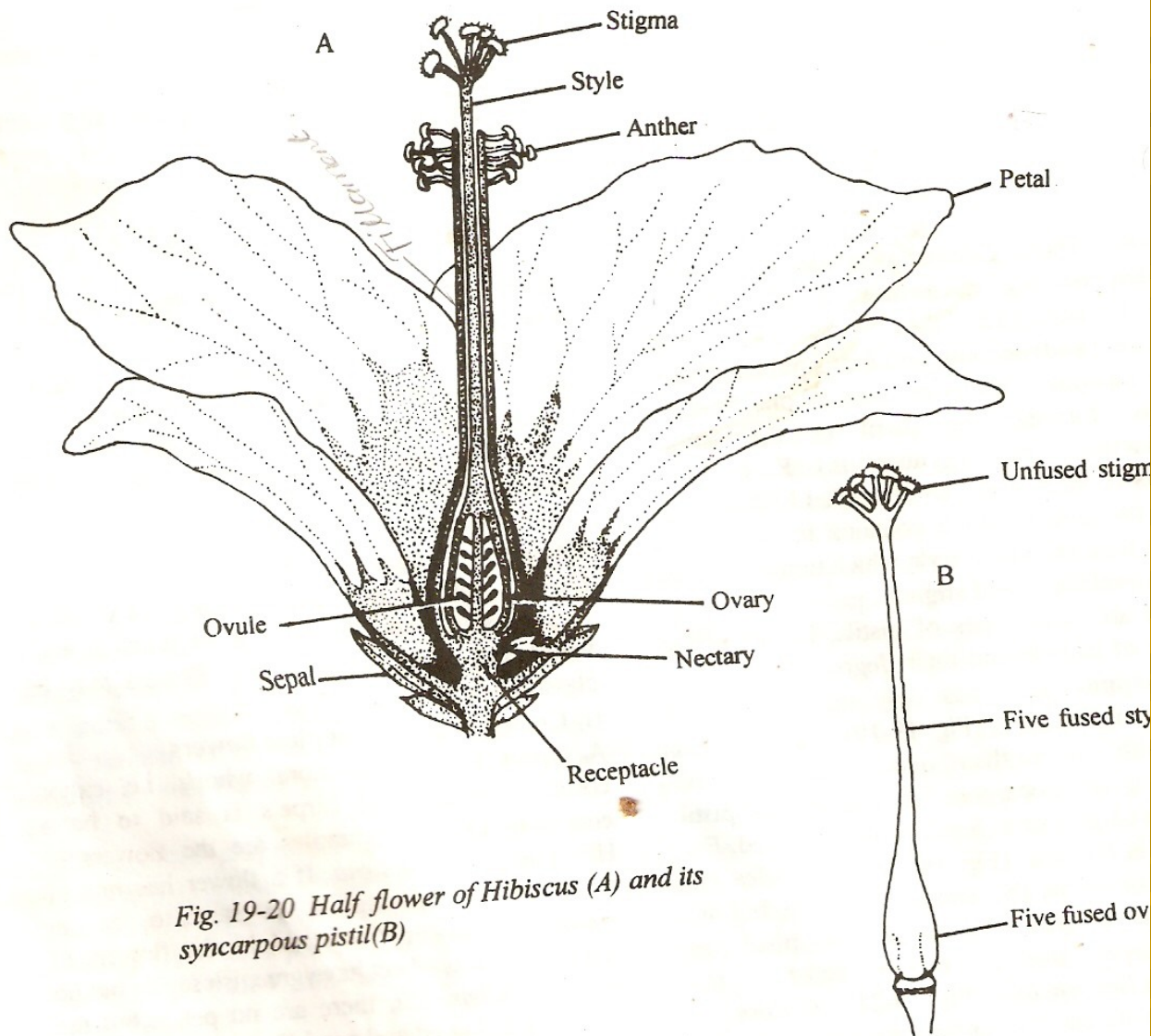


Fig. 19-19 Flower of *Clotaralia* (A) Half flower (B) Flower with petals removed

- Has only one carpel e.g. *Clotaralia*/peas

## b) Syncarpous Pistil

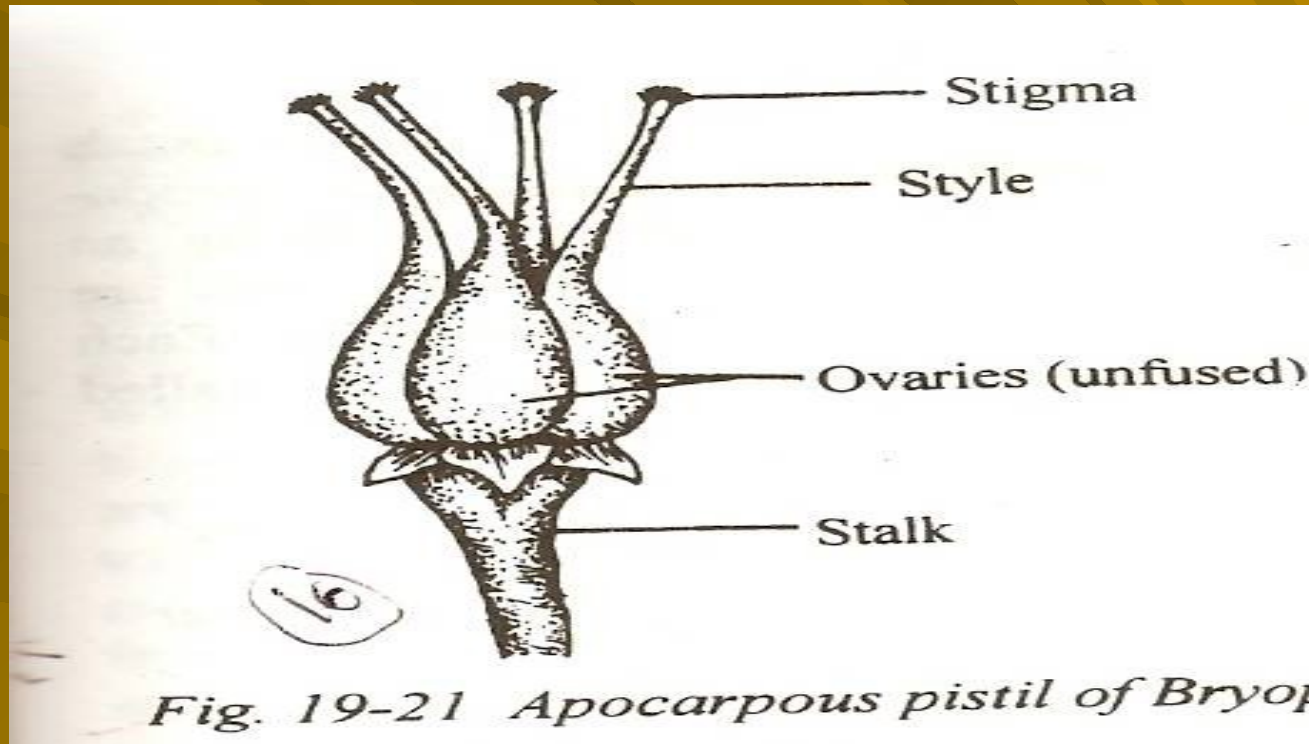


Has more than one carpel

It has all its carpels or at least its ovaries fused e.g in Hibiscus

The ovaries and the style of all the five carpels are fused but the stigmas are separate

## c) Apocarpous pistil



- Has several carpels that are entirely separate e.g. Bryophyllum, Rose

# Types of ovaries

- Inferior / Epigynous ovary.
- Superior / hypogynous ovary.
- Perigynous.

## a) Epigynous

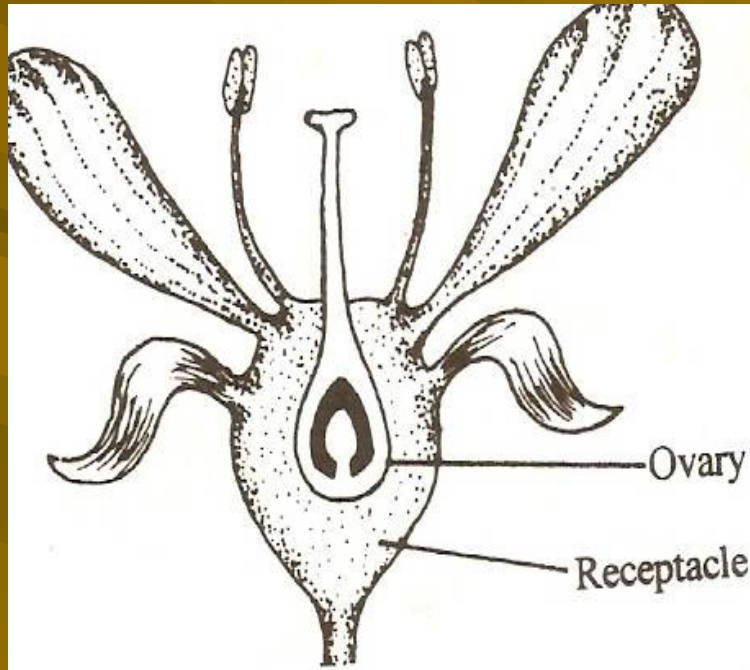
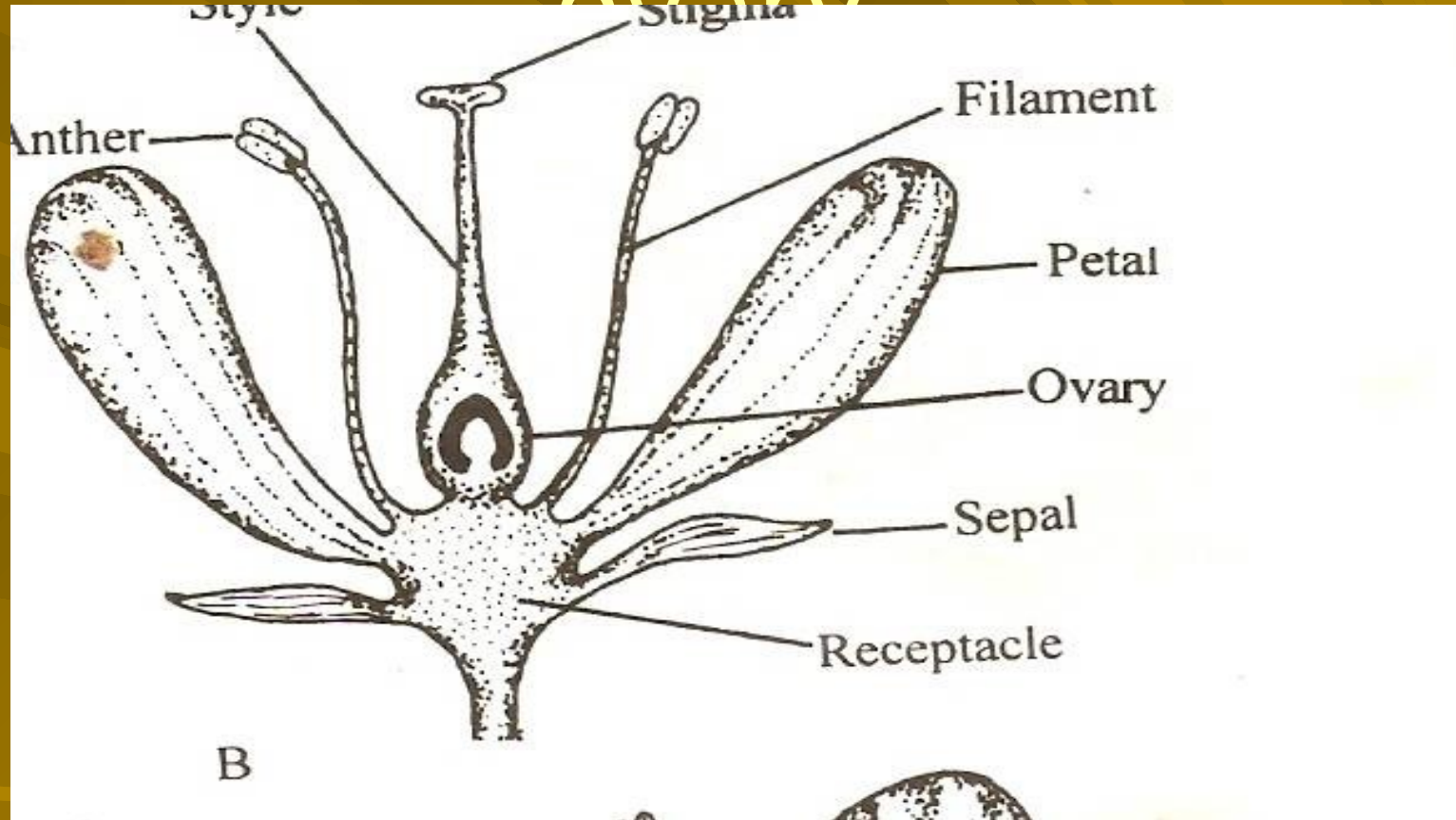


Fig. 19-23 (A) A superior ovary and (B) an inferior ovary

-when the position of the ovary on the receptacle is such that the other floral parts occur above it, it is said to be inferior or **epigynous ovary**.  
As in apple

## b) Superior/ Hypogynous ovary



- When the ovary is above other floral parts e.g as in Hibiscus

## c) Perigynous ovary

- When the receptacle completely encloses the carpel with other floral parts arising above the ovary

# VARIATIONS IN FLORAL STRUCTURE

- Flowers from different plants show great variation in size, shape and the number of units in each whorl.
- Based on their structure, flowers may be classified as follows; or described as follows;

## 1. **Complete and incomplete flower**

**A complete flower** is a flower with all the floral whorls. E.g Hibiscus, Croton.

- If a flower has one or more whorls missing, it is said to be **an incomplete flower** e.g-Flowers of spinach and sugar beet have greenish sepals no petals.-In Clematis, No petals but the sepals are

## 2 Universal flower vs. Bisexual flower

- **A unisexual flower** is a flower with only one of the reproductive parts. It may either be a male or a female flower
- **Bisexual (hermaphrodite) flower**- Has both the male and the female reproductive organs i.e. it is a complete flower.

### 3. Staminate vs pistillate flower

**A unisexual flower** has one of the reproductive parts of a flower; i.e.

- **Staminate**
  - When only the male part are present in a unisexual flower.
  - A male flower
- **Pistillate**
  - When the stamens are missing in a unisexual flower
  - A female flower

## 4. Monoecious vs. Dioecious

### Monoecious plants

- Are those plants which bear staminate or pistillate flowers separately but on the same individual plant. E.g maize, the tassel consist of a group of staminate flowers whereas the young ear consist of a group of pistillate flowers. Also in oil palm.

carpels are called bisexual flowers

Tassel (staminate flowers)

Young ear (pistillate flowers)

Fig. 19-22 A maize plant illustrating the monoecious flower arrangement

# Dioecious plants

- These are plants which bear staminate and pistillate flowers on different individual plants i.e. a plant can either be a male or a female plant. Example ; pawpaw, Asparagus and Date palms.

## 5 Regular (Actinomorphic) vs. Irregular (Zygomorphic) flower.

### ■ Regular Flowers

- Flowers that can be divided into two similar halves by any vertical section passing through the centre e.g. Morning glory

- Such flowers may always be radially symmetrical.

### ■ Irregular Flowers

- Flowers that can be divided into two equal halves in one particular plane only eg Crotonaria

# 6 Solitary vs. Inflorescence

Solitary flowers - are those that occur singly.

Inflorescence - are those flowers that grow in clusters.

# Essential vs. Non-essential parts of the flower

- Non-essential – parts not directly involved in reproduction in the flower.e.g Calyx and corolla
- Essential parts of the flower – parts directly involved in the reproduction in the flower.e.g androecium and gynoecium are essential parts.

# Sessile vs Pedicillate flower

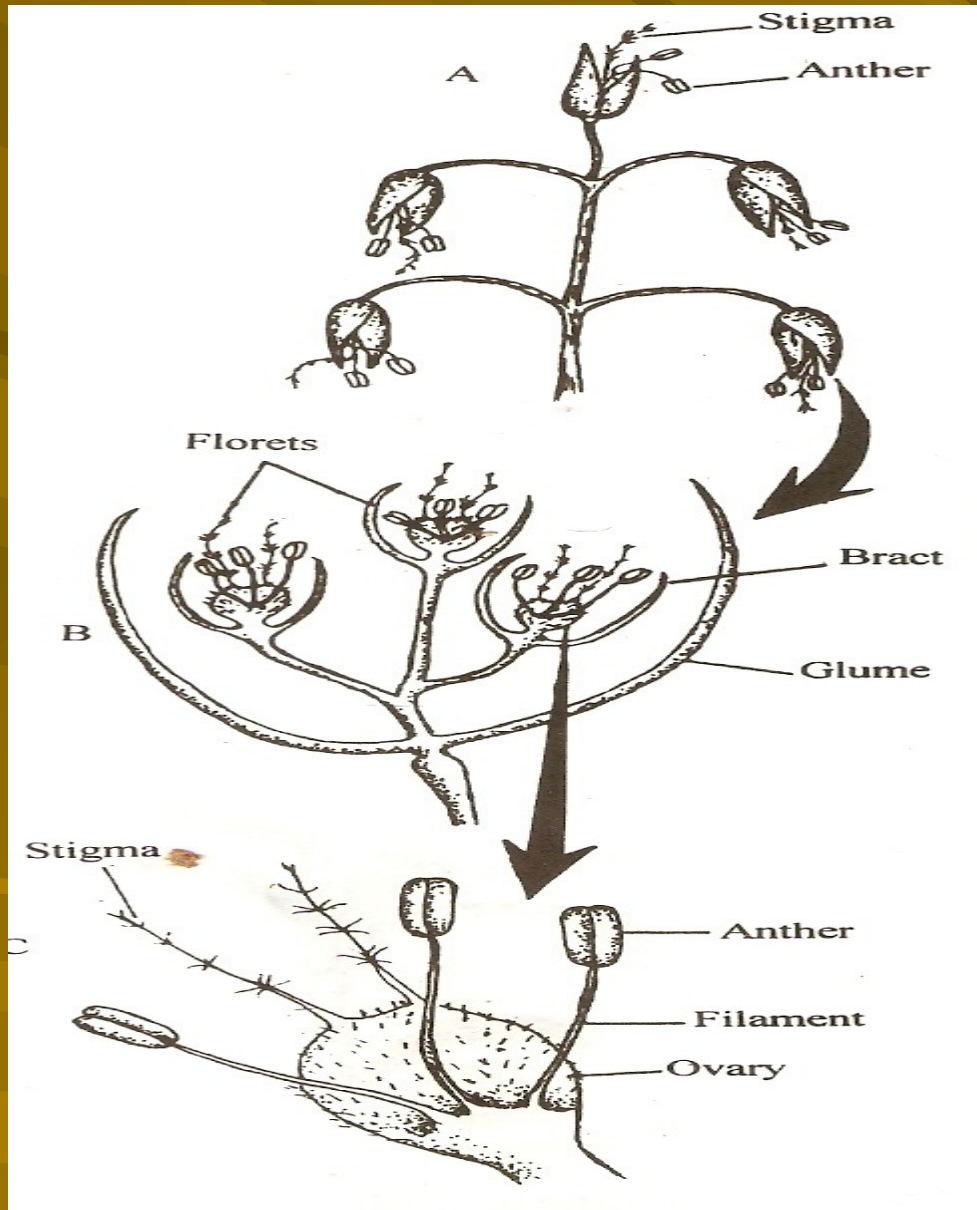
Sessile flower - Flower without a stalk

Pedicillate flower - Flower with a stalk

# INFLORESCENCE

- This is when many flowers are borne on the same branch or closely associated branches.
- Examples - Flowers of grasses
  - Sunflower
  - Dahlia

# THE GRASS FLOWER



- Has no sepals or petals and are usually wind pollinated.
- Produced in closely associated branches forming an inflorescence.
- Individual florets are associated in groups known as spikelet.
- Each spikelet is enclosed by a leaf like structure called glume.
- Separation of glumes reveal that each individual florets of spikelet attached to a slender stalk.
- Each individual floret is enclosed by a bract.

- The Androecium- consist of three stamens.
- Gynoecium – consist of two fused carpels } Both devd within the protective bracts.
- When the flower mature, the bracts separate exposing the stigmas and the stamens.
- The stigmas are long and feathery (Trap pollen grains floating in air)

- The filaments are long which allows anthers to hang free from the spikelet.
- The filaments are very slender and shake with the slightest wind.
- The anthers burst and release light pollen grains that are carried by wind to stigmas of the other flowers.

# GAMETOGENESIS IN FLOWERING PLANTS

- Gametogenesis is the formation of both male and female gametes in the flowering plants.
- Gametes are either produced;
  - On the same flower on the same plant.      On different plant on the same plant
  - On different plants

# A) POLLEN GRAIN FORMATION

- Takes place on the same plant
- The anther of the stamen consist of two or four chambers called pollen sacs
- Each pollen sac contains a mass of large diploid cells called pollen mother cells
- Each mother cell undergoes meiosis to produce four haploid cells called a tetrad
- The cells forming a tetrad separate and acquire a specific structure to become a pollen grain

- The haploid nucleus of each tetrad (pollen grain) divides by mitosis to form generative nucleus and tube nucleus
- The division is accompanied by thickening and sculpturing of the pollen grain wall forming a mature pollen grain
- The pollen grain is ready for pollination

## B)FORMATION OF OVULES

- Ovules are formed in the ovary
- Within the hollow ovary is one or more protuberances called ovules which eventually become seeds
- The growth of the protuberance increases in size as the cells continue to divide and it is held by a short stalk called the funicle
- The funicle is held to the ovary wall by a special tissue called the placenta

- Each ovule consist of a uniform mass of cells called Nucellus
- As the ovule enlarges two layers of cells arise from its base and develop into a protective inner and outer integuments enclosing the soft nucleus tissue
- The integuments do not entirely enclose the nucleus but leave a small opening called the microphyle at the apex of the ovule

- In the center of the young ovule is a large cell with a dense cytoplasm ref  
embryosac mother cell
- The embryo sac mother cell  
undergoes division by meiosis to  
form a row of four haploid cells
- Three of these cells (ones nearest to  
microphyle) degenerate and the one  
that is left forms the embryosac

- Embryo sac nucleus undergoes three successful mitotic divisions to form eight haploid nuclei. A vacuole is developed by expansion
- These nuclei separate into two sets; one set moves towards the chalaza, the other set of four nuclei migrate to near the microphyle

- One nucleus from each set moves to the center of embryo sac to form the polar nuclei which will be involved in fertilization
- The remaining six nuclei become enclosed with cell membranes
- One of the cells (nucleus) at the microphyle end of the ovule becomes the functional female gamete (egg). The other two are non-functional eggs hence ref as synergids and they eventually disintegrate

- The three cells at the furthest end of the microphyle (chalaza) are referred to as antipodal cells and also disintegrate

# POLLINATION

- Ref Transfer of pollen grains from anther to the stigma
- If the pollen grains are transferred to the stigmas of the same flower or another flower on the same plant it is ref to as self pollination. When the pollen are transferred to another stigma of another plant of the same species, it is ref to as cross pollination

- In self pollination- There is no genetic mixing and the off springs are similar to the parent. If this occurs in several generations , it results in a decline of vigour and productivity
- In cross pollination- Enables the mixing of the genetic qualities between different plants. It is generally observed that the offsprings of cross pollination are –more vigorous,- have high productivity,- more resistant to diseases than those of self pollination. This is called Hybrid vigour

# FACTORS THAT ENCOURAGE CROSS POLLINATION

- Anthers situated below the level of the stigma
- The stamens, whole flower or inflorescence may hang downwards so as to ensure wide scattering of pollen grains away from the parent plant
- Anthers may be borne on long flexible filaments

- Brightly coloured petals, sepals, perianth or bract may attract insects
- Production of scent to attract insects
- Presence of nectar to act as a bait for insects
- Nectaries being located deep down at the base of the corolla tube
- Nectar guides presence to direct the insect

- Presence of sticky pollen grains
- Stamens and carpels within a flower may mature at different times (dichogony). Stamens ripens first (protandrous condition) eg in geranium. Carpels ripen before the stamens (protogynous condition)
- Stamens and carpels may be located on different flowers ie the flowers are unisexual

- Self sterility- in some plants, pollen will not develop on, and indeed may poison, a stigma of the same plant e.g in certain orchids.