CELL DIVISION

Reproduction involves the multiplication of cells in order to multiply, cells undergo cell division. One divides into two, two into four, four into eight and so on. Cell division does not necessarily mean halving the cell and its contents but forming new components to form daughter cells.

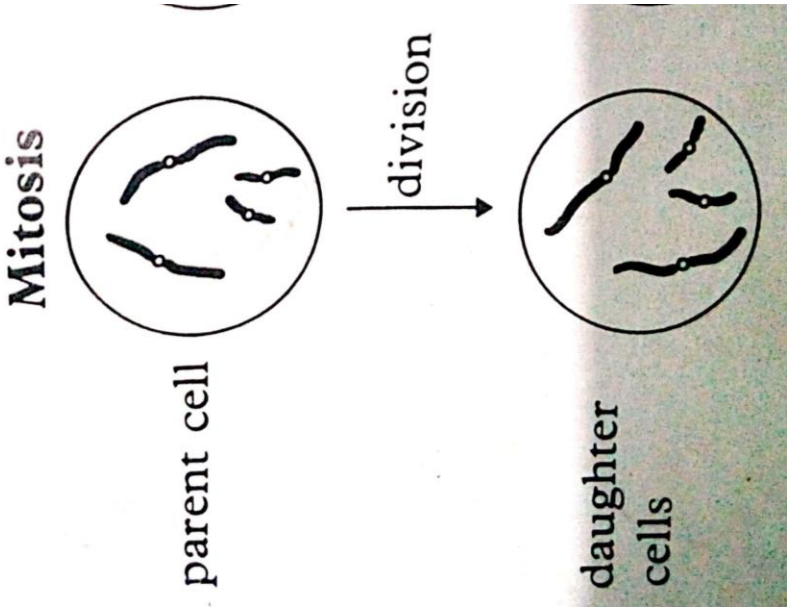
Cell division involves two types

i. Mitotic cell division (mitosis)
ii. Meiotic cell division (meiosis)

Cell division involves nuclear division followed by cytoplasm division immediately (cytokinesis) both of which comprise a cell cycle

MITOSIS

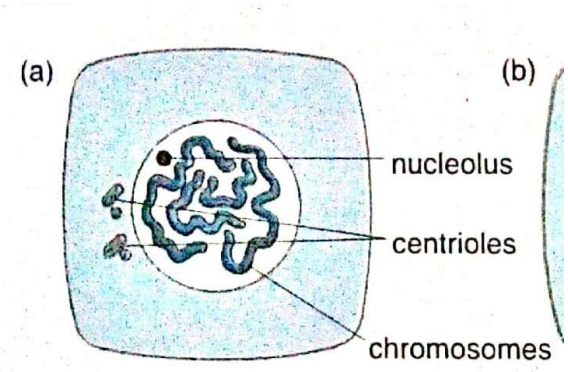
This is the type of cell division in which the parent cell divides into two daughter cells each having the same number of chromosomes as the parent cell.



This type of division involves four stages Prophase, Metaphase, Anaphase and Telophase. And a main growth and resting phase Interphase. The whole process of cell division can take an hour or two roughly

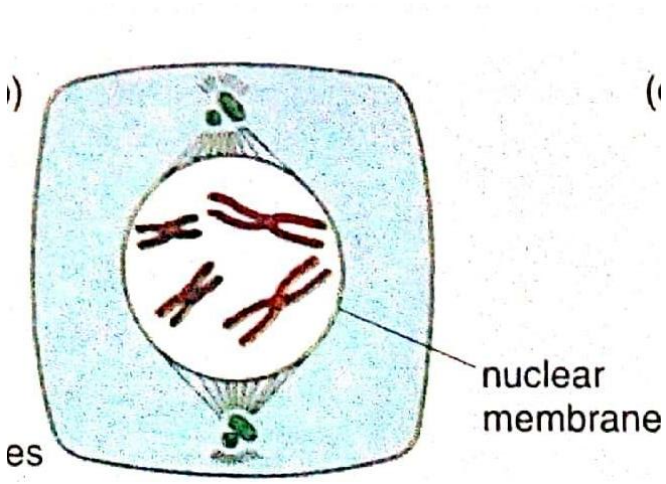
Interphase (replication)

- Chromosomes not visible (are thread like)
- Chromatins present
- Centrioles replicate
- Replication of DNA (double)
- Production of ATP (energy)
- Formation of new organelles (mitochondria, ribosome, chloroplast), duplication



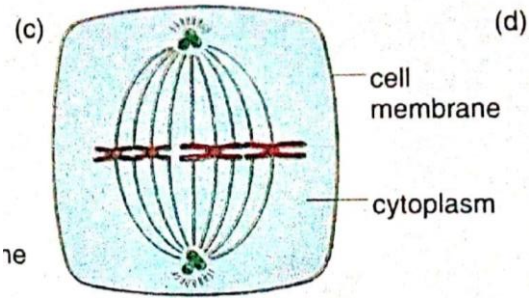
Prophase (thickening)

- Chromatin threads condense to form distinct chromosomes (chromosomes formed from the chromatids are joined at the centromere)
- Centrioles at opposite sides of the nucleus
- Spindle fibres start to form
- Nucleolus disappears
- Nuclear membrane breaks down



Metaphase (arrangement)

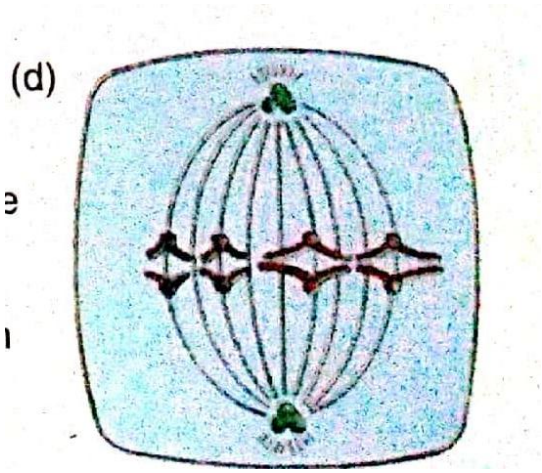
- Chromosomes arrange themselves on equator of spindle
- Homologous chromosomes do not associate
- Chromatids draw apart at the centromere towards opposite poles
- Chromosomes migrate at the equator



Anaphase (migration)

- Spindle fibres contract and shorten
- Sister Chromatids part company and migrate to opposite poles of the cell with the centromeres leading
- Chromosomes reach their destination

- Spindle fibres begin to break down.



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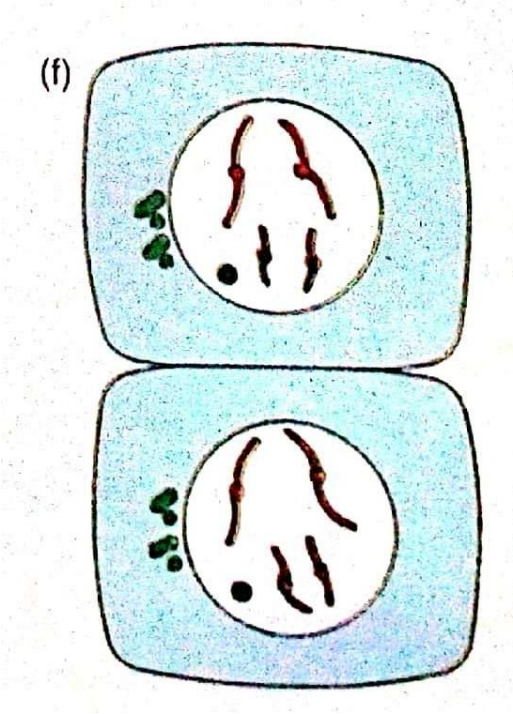
Telophase (cell constrict)

- Cell membrane starts to constrict across the middle
- Nuclear membrane reforms
- Nucleolus reform
- Spindle apparatus degenerates
- Cytoplasm divides into two new daughter cells with exact number of chromosomes as the parent cell
- Chromosomes uncoil, become thread like



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There are two features in mitosis that ensure that the chromosome constitution is preserved

- Replication of chromosomes before cell division
- Arrangement of the chromosome on the spindle

Roles of mitosis

- Growth of an organisms e.g. development of fertilized egg into adult
- Asexual reproduction e.g. protest with binary fission
- Genetic stability (no variation)
- Cell replacement e.g. skin cells
- Regeneration e.g. legs in crustacean and arms in star fish

Differences between mitosis in plants and animal cells

Plant	Animal
No	Centrioles present
No	Aster form
Cell division involves formation of a cell plate	Cell division involves cleavage of cytoplasm
Occurs mainly at meristems	Occurs in tissue throughout the body

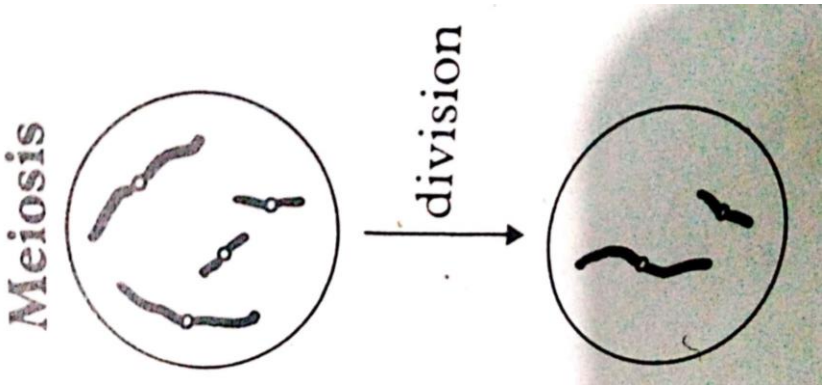
Note: Species in which there are two sets of chromosomes are referred to as diploid (2n) animals. Those with one set of chromosomes are referred to as haploid (n). Some plants are polyploid

Advantages of diploid

- ✓ Genetic variation is increased
- ✓ There is back up for funny genes

MEIOSIS

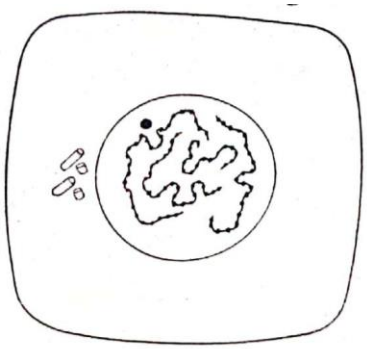
This is the type of cell division in which diploid parent cell divides into four daughter cells each having half the number of chromosomes as the parent cell.



Contrary to mitosis, meiosis consists of two successive divisions 1^{st} meiotic division were the parent divides into two and the 2^{nd} meiotic division were the products divide to produce four daughter cells. The process involves the four stages Prophase, Metaphase, Anaphase and Telophase but distinguish by I or II for the first and second meiotic division respectively

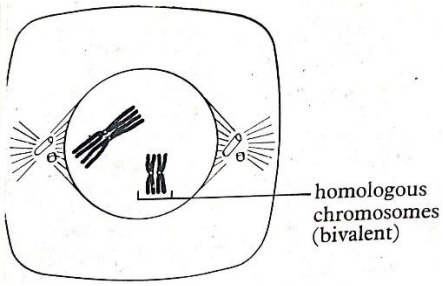
Interphase

- Chromosomes not visible are thread like
- Chromatins present
- Replication of DNA
- Production of ATP
- Formation of new organelles



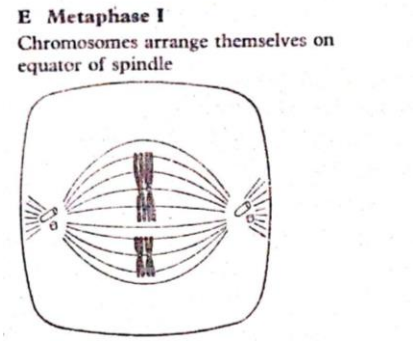
Prophase I

- Nucleolus disappears
- Centrioles arranged on opposite sides of nucleus
- Spindles form
- Chromosomes condense
- Homologous chromosomes come together (synapsis) forming a bivalent



Metaphase I

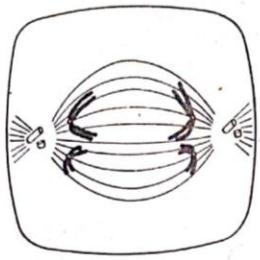
- Homologous chromosomes move to the equator of the spindle together(behaves as a unit)



Anaphase I

- Homologous chromosomes part company move towards opposite poles of the spindle

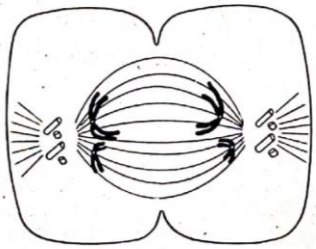
F Anaphase I
Homologous chromosomes part company and migrate to opposite poles of the cell.



Telophase I

- The chromosomes have reached their destination and the cell constricts across the middle as in mitosis

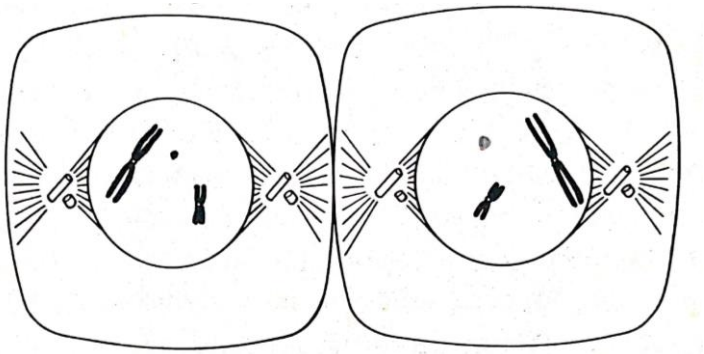
G Telophase I
The chromosomes have reached their destination and the cell constricts across the middle as in mitosis.



2nd meiotic division aims at separating Chromatids

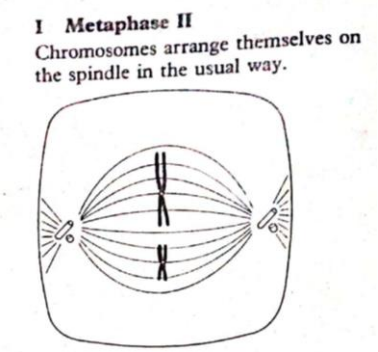
Prophase II

- Two daughter cells prepare for the 2nd division
- Centrioles replicated
- New spindles are formed



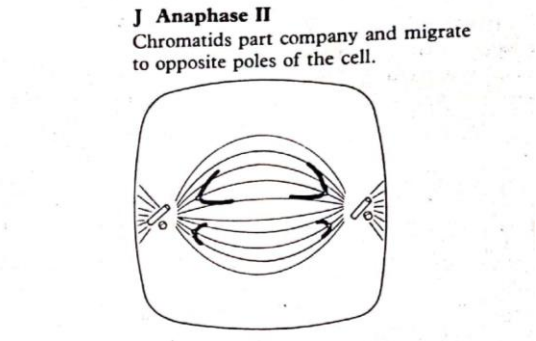
Metaphase II

- Chromosomes arrange themselves on the spindle in the usual way



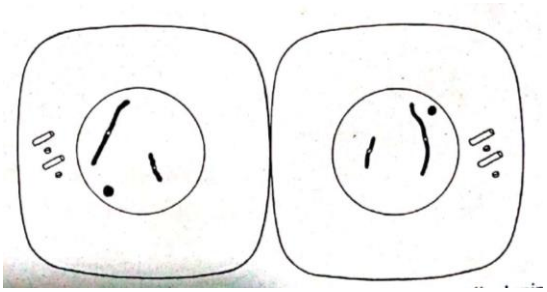
Anaphase II

- Chromatids part company and arrange to opposite poles of the cell



Telophase II

- Cells constrict across the middle
- The nuclear membrane and nuclei reform



Significance of meiosis

- Sexual reproduction which involves production of gametes
- Genetic variation : provides opportunity for new combinations of genes to occur in the gametes the is through crossing over and independent assortment

1. Independent assortment
   Orientation of bivalents at the equator of the spindle in metaphase I is random. The bivalents line up independently and therefore the chromosomes in each bivalent separate (assort) independently of these in other bivalents during anaphase I
2. Crossing over
   As a result of chiasmata, crossover of segments of Chromatids occurs between homologous chromosomes during prophase I leading to the formation of new combinations of genes on the chromosomes of the gametes.

Similarities between mitosis and meiosis

- Both begin with diploid nucleus
- Both have single duplication
- Have similar stages
- In both there is spindle formation
- In both chromosome arrange at the equator

Differences between mitosis and meiosis

STAGE	MITOSIS	MEIOSIS
Prophase	- Homologous chromosomes remain separate - No formation of chiasmata - No crossing over	- Homologous chromosomes pair up - Chiasmata form - Crossing over may occur
Metaphase	- Pairs of Chromatids lineup on the equator of spindle	- Pairs of chromosomes lineup on the equator of spindle
Anaphase	- Centromeres divide - Chromatids separate - Separating Chromatids identical	- Centromeres do not divide - Whole chromosomes separates - Separating chromosomes and their Chromatids may not be identical due to

		crossing over
Telophase	- Same number of chromosomes in daughter cells as parent cells - Bothe homologous chromosomes present in daughter cells if diploid. -	- Half - Only one of each pair
Occurrence	- May occur in haploid, diploid or polyploidy cells - Occurs during formation of somatic cells and some spores - Formation of gametes in plants	- Only occurs in diploid or polyploidy cells - Occurs during formation of gametes or spores