

CLASS - XTEACHER - Ms Nidhi Rana

20.05.2024

CHAPTER - 2 Cell Cycle, Cell division
and Structure of Chromosome

This lesson is for Class X, for the subject of Biology Topic 'Cell division' which is covered in Chapter 2 titled - Cell cycle, cell division and Structure of chromosome starting on Page No 8 of your text book titled Concise Biology - Selina Publications.

Dear children Let us start with -

Cell Division - 2 types -

- (i) Mitosis - occurring in normal body cells (somatic cells) Daughter cells that are formed are diploid ($2n$) having same number of chromosomes as the parent cell. Two daughter cells are produced after division.
- (ii) Meiosis - occurring in reproductive cells leading to formation of gametes (sperms or eggs) which are haploid (n) having half number of chromosomes as in the parent cell. 4 daughter cells are produced after division.

Mitosis

Cell division in which one parent cell divides into two identical daughter cells.

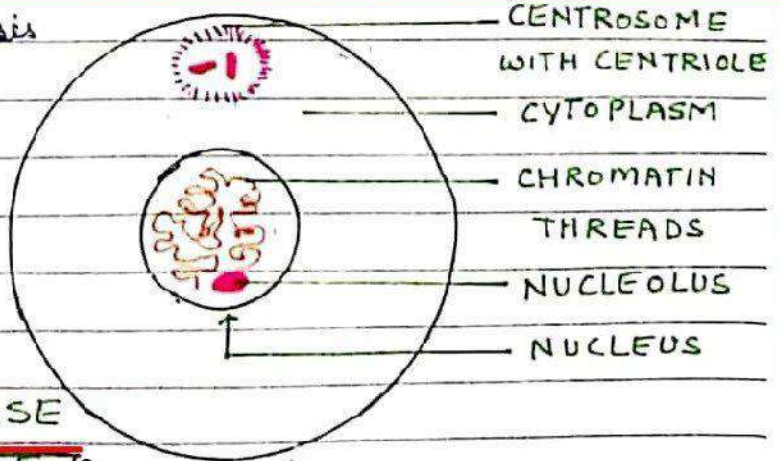
Phase - 1) Karyokinesis [Division of nucleus]
2) Cytokinesis [Division of cytoplasm]

1) Karyokinesis - occurs in 4 phases merging into each other thereby making it a continuous process. These phases are, by and large, similar in both animals and plant cells. So Let's discuss these phases in animal cell.

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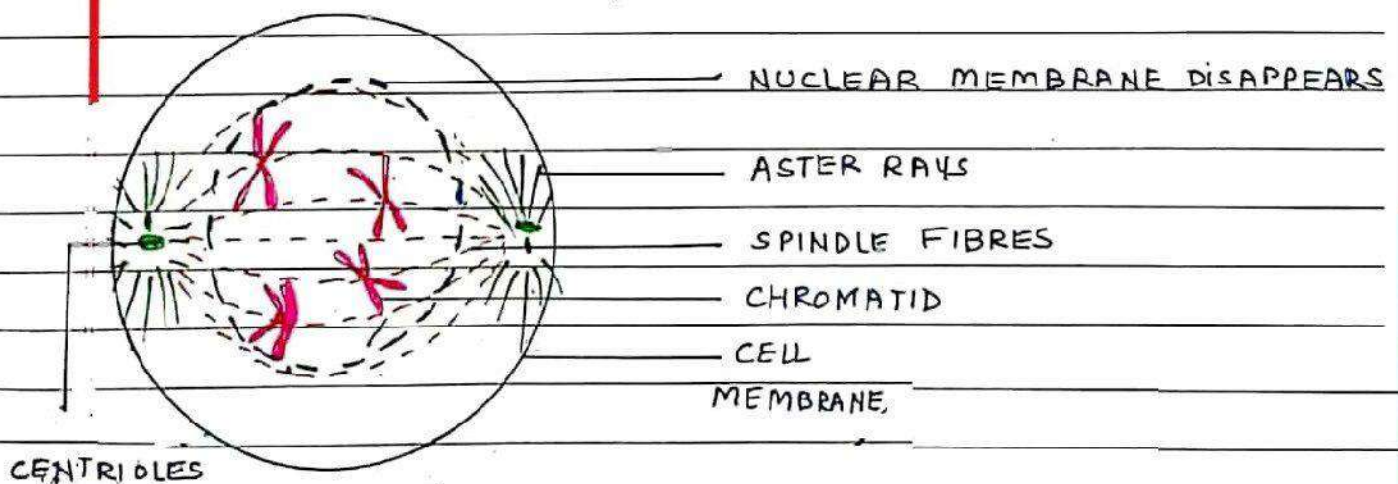
Before the Karyokinesis begins the cell is in Interphase with no visible change in chromosomes but active synthesis of DNA



INTERPHASE
[RESTING PHASE]-2-

I Prophase

- 1) Chromosomes become short and thick and clearly visible
- 2) Each chromosome has been duplicated to form 2 chromatids
- 3) Two chromatids remain attached at centromere
- 4) Centrosome (in animal cell) splits into two along with simultaneous duplication of centrioles contained in it. Daughter centrioles move apart and reach the opposite poles of the cell. Each centriole is surrounded by radiating rays called aster rays
- 5) A number of fibres appear between two daughter centrioles, which are called the spindle fibres.
- 6) Nuclear membrane and nucleolus disappear
- 7) Duplicated chromosomes start moving towards the "equator" of the cell.



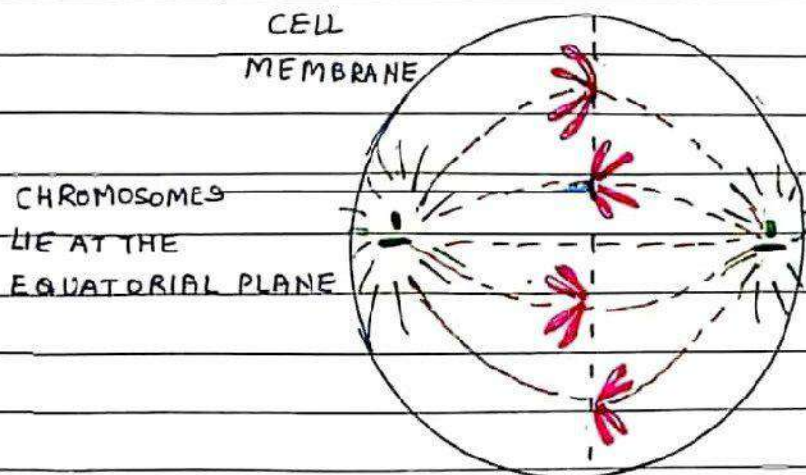
PROPHASE

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II Metaphase

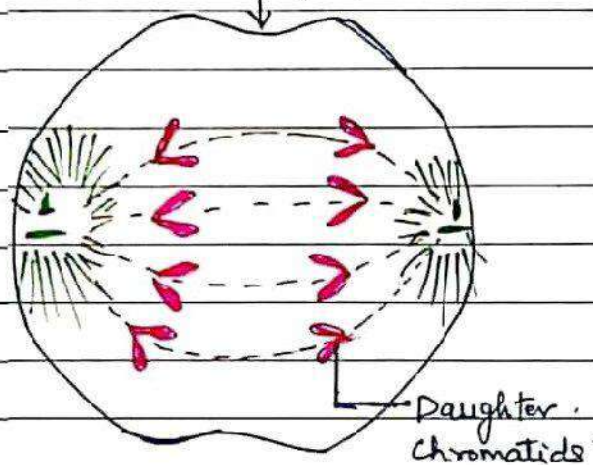
- 1) Each chromosome gets attached to spindle by its centromere
- 2) Chromosomes line up in one plane at the equator



III Anaphase

- 1) Centriosome attaching the two chromatids divides
- 2) The two sister chromatids of each chromosome separate and are drawn apart towards opposite poles pulled by shortening of spindle fibres.
- 3) A furrow starts in a cell membrane at the middle in animal cell

Furrow in cytoplasm



Sister chromatids separate
& move to opposite poles

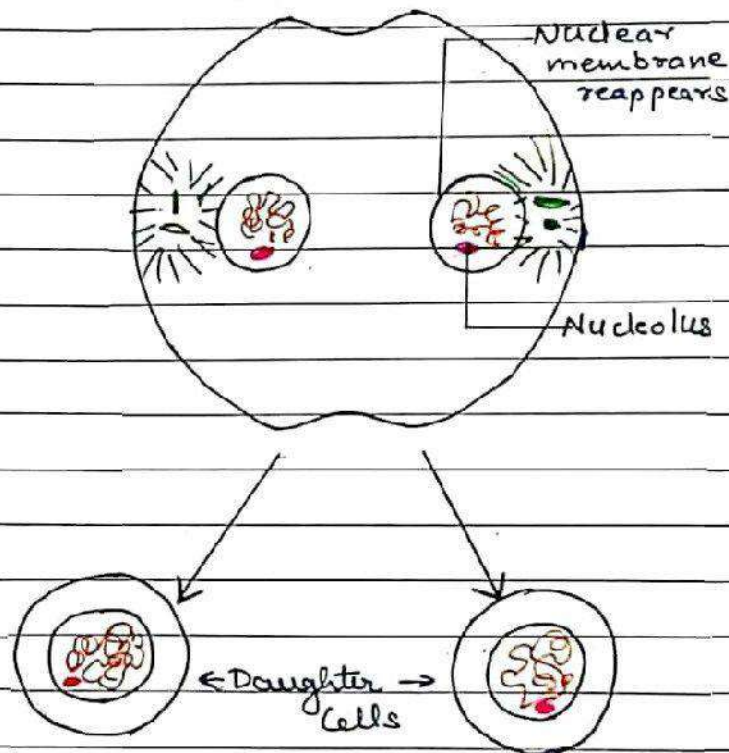
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IV

Telophase

- 1) Two sets of daughter chromosomes reach opposite poles.
- 2) Spindle fibres disappear
- 3) Chromatids thin out in the form of chromatin fibres
- 4) Nuclear membrane is formed
- 5) The cleavage furrow starts deepening in the animal cell.
- 6) Nucleoli reappear

TELOPHASE

Now before going further let us take a short break. Answer the following questions during break

Q1. Give the term for - Division of Cytoplasm

Q2. In which phase of mitosis do the chromosomes line up in one plane at the equator

Q3. Name the phase of mitosis in which the chromatids thin out in form of chromatin fibres.

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You may pause the lesson for 3mins now and write the answers to above questions in notebook.

Break is over children. Listen to correct answers

A1. Cytokinesis

A2. Metaphase

A3. Telophase

Now let us resume the topic with the discussion of -

Cytokinesis

After Karyokinesis, a furrow appears in the cell membrane in the middle, which deepens and finally splits the cytoplasm into two, thus producing two new cells.

Differences between mitosis in -

- 1) Animal cell - 1) Asters are formed (centrioles present)
2) Cytokinesis by furrowing of cytoplasm. Furrow starts from cell membrane (outside) which then proceeds to the centre of the cell.
3) Occurs in somatic cells, general body cells for growth throughout the body.

2) Plant Cell

- 1) Asters are not formed [centrioles absent]
2) Cytokinesis by cell plate formation. Cell plate is formed at the centre of the cell which then grows and extends towards the cell membrane (outside)
3) Occurs mainly at the growing tips (for lengthening) and sides (for increase in girth)

Significance of Mitosis

1. Helps in growth of body size due to formation of new cells.
2. Helps in repair of damaged cells
3. Helps in replacement of old dead cells
4. Asexual reproduction in unicellular organisms. occurs through mitosis
5. It helps to maintain same chromosome number in daughter cells.

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Meiosis - produces gametes/sex cells with half the number of chromosomes. It occurs in reproductive organs (testis in males and ovary in females) to produce sperms and ova.

In flowering plants it occurs in anthers

to produce pollen grains and ovule to produce egg cell / female gametophyte

Meiosis is called reductional division as it reduces the number of chromosomes in daughter cells. For eg in humans out of 23 pairs of (46) chromosomes only single chromosome i.e. one member of each pair (haploid) are passed on to the sex cells.

This is essential because after fertilization the normal double (diploid) $2n$ number of chromosomes (in pairs) is reacquired in offspring.

Diploid is expressed as $2n$ (46 chromosomes in humans; ^{normal cells})

Haploid is expressed as n (23 chromosomes in gametes of humans)

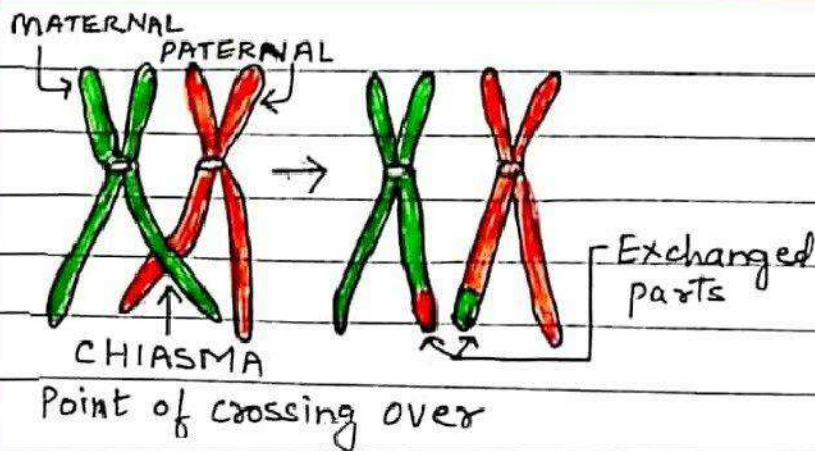
Stages of Meiosis are not in syllabus.

Significance of Meiosis.

1. Chromosome number is halved in gametes so that on fertilization, the normal ($2n$) is restored
2. It provides for mixing up of genes in two ways -
 - (i) Maternal and paternal chromosomes get mixed up during Meiosis I as they separate from homologous pairs.
 - (ii) Crossing over - While maternal and paternal chromosomes are separating, the chromatid material very often gets exchanged between the two members of a homologous pair which results in genetic recombination. This is called crossing over.

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Chiasma is the X-shaped structure formed due to crossing-over between non-sister chromatids of paired homologous chromosomes

With this I am ending today's discussion children. On the basis of your understanding of today's topic all students are required to answer the following home assignment questions in the notebooks.

Home assignment

Q1. Draw well labelled diagrams of all the stages of Mitosis in notebook.

- 1) Interphase
- 2) Prophase
- 3) Metaphase
- 4) Anaphase
- 5) Telophase

Also write down the characteristic feature of all these phases.

Q2. Learn and write down the differences between Mitosis and Meiosis given on Page 18 Table 2.2.