

## Chapter 10 Cell cycle and cell division

### ★ M phase (mitosis phase) (1 hour)

- ⇒ Microtubule (spindle fibres); Origin - Zitate
- ⇒ Takes place in somatic cells (both haploid & diploid)
- ⇒ also in cancer cell during multiplication phase
- ⇒ Equational division (same chromosome no. as in the parent cell)
- ⇒ Two stages

- \* Karyokinesis
- \* Cytokinesis

### ★ Prophase

- ⇒ Chromosomal material condensed to form compact mitotic chromosome
- ⇒ Nuclear membrane dissociates
- ⇒ chromosomes are seen to be composed of two chromatids attached together
- ⇒ duplicated centrosome begins to move towards opposite poles of the cell
- ⇒ each centrosome radiates out microtubules called **Asters**
- ⇒ 2 Asters together with spindle fibres forms **Mitotic apparatus**
- ⇒ Cells at the end of prophase do not show golgi apparatus, ER, nucleolus and the nuclear envelope

### ★ Metaphase

- ⇒ Condensation of chromosomes is completed
- ⇒ Metaphase chromosome are held together by

Centromeres and made up of 2 sister chromatids  
easily studied

⇒ Small disc-shaped structures at the surface of the centromeres are called **kinetochores** where the spindle **attach from opp. pole**

⇒ chromosomes align on equatorial plate due to differential contraction of chromosomal spindle fibre on poles

### Anaphase

⇒ The two daughter chromatids with centromeres split  
⇒ Chromatids move to opp poles as spindle fibres condensed to pull

### Telophase

⇒ At the beginning - chromosomes reached resp poles & cytokinesis starts

⇒ Chromosomes decondense and lose their individuality and chromosome cluster is formed

⇒ Nuclear envelope develops

⇒ forming two daughter nuclei

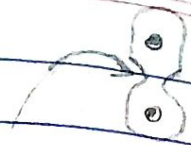
⇒ Nucleolus, golgi apparatus and ER Reform

⇒ chromosome decondensed for is chromatin fibre

⇒ Aster rays, spindle fibres dissociate

[Reversal process of Prophase]

## ★ Cytokinesis



- ⇒ In animal cell achieved by furrow in plasma membrane
- ⇒ In plants wall formation in the centre and grows outwards to meet existing lateral walls
- ⇒ The formation of new cell wall begins due to the formation of ~~two~~ simple precursor called **cell plate** represents middle lamella between the walls
- ⇒ furrow is not possible in plant cell because of the rigid cell wall
- ⇒ by this time organelles like mitochondria, plastids are distributed
  
- ⇒ In some organisms karyokinesis is not followed by cytokinesis as a result of which multinucleate condition arises leading to formation of **Synkium** ex.: liquid endosperm in coconut

## ★ Significance of Mitosis

- ⇒ Growth: Mitosis is essential for growth in multicellular organisms
- ⇒ Reproduction: Unicellular - Asexual reproduction, Plants - Vegetative prop.
- ⇒ Repair: replace dead and worn out cells by Mitosis
- ⇒ Healing and Regeneration: Mitosis produce new cells for healing wounds
- ⇒ Genetic stability: Maintenance of chromosome no. identical to parent cells
  
- ⇒ Maintenance of the size

## \* Interphase (23 hours) \*

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⇒ It is also known as Resting phase  
⇒ It is the time ~~duration~~ during which the cell prepares for division by undergoing cell growth and DNA replication

\* G<sub>1</sub> phase (Gap 1) ⇒ Initiation of DNA, Metabolically active and continuously grows

\* ~~G<sub>2</sub>~~ S phase (Synthesis) ⇒ DNA Replication during this period amount of DNA doubles but no increase chromosome no.

\* If it is a animal cell Centrioles duplicates in cytoplasm

\* G<sub>2</sub> phase (Gap 2) ⇒ Protein synthesis which involves in mitosis ~~while~~ while the cell growth continues

⇒ Some cells do not ~~under~~ go division in an adult  
Ex: Heart cell, Nerve cell

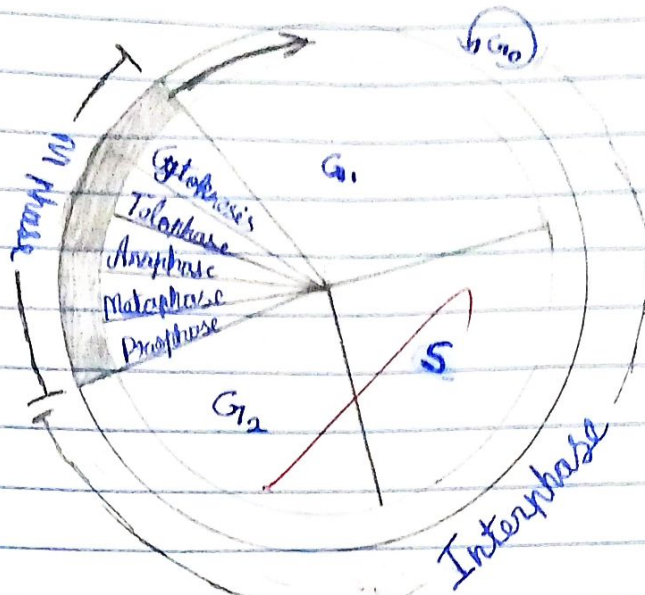
⇒ Some cells may divide occasionally, as per the needs that have been ~~to~~ lost because of injury or cell death

⇒ These cells that do not divide further exit G<sub>1</sub> phase and enter into an inactive stage called quiescent stage G<sub>0</sub> cells at this stage are metabolically active but not proliferate unless there is a need

⇒ In animals mitotic cell division takes place ~~only~~ only in diploid somatic cells (ept: in Male honey bees can show division in haploid cells)

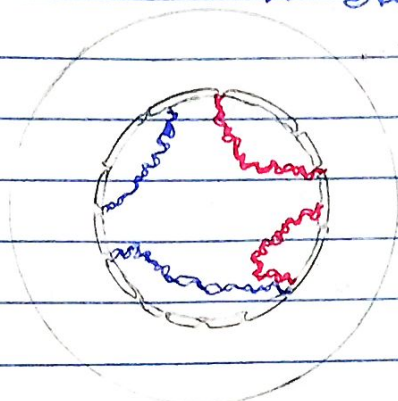
⇒ Yeast cell cycle take place every 90 minutes

★ Cell cycle and Cell division, All diagrams

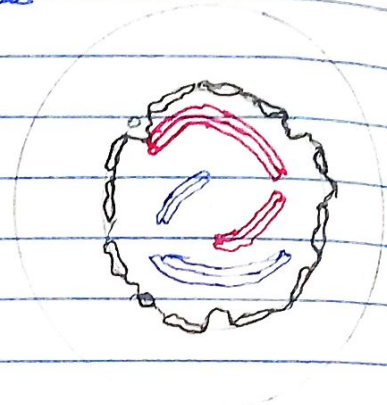


Cell Cycle

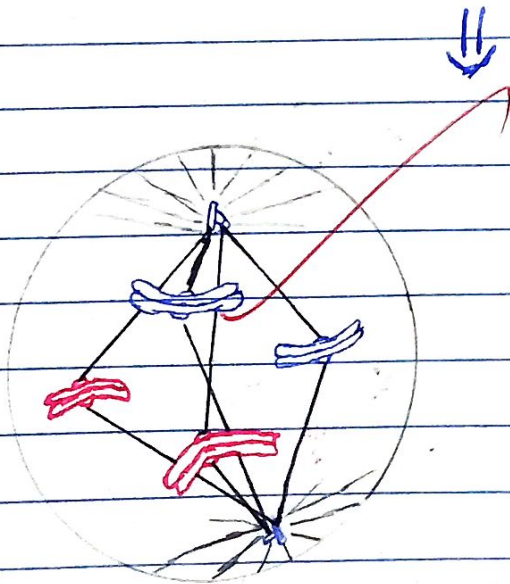
★ Stages of Mitosis



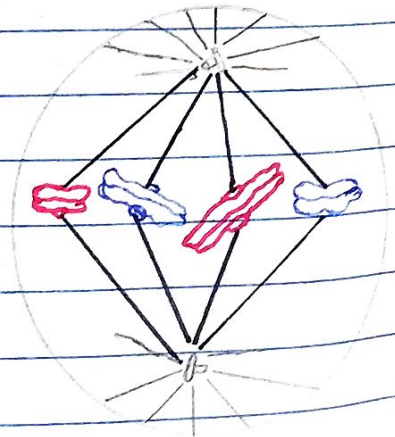
Early prophase



Late prophase



Transition to Metaphase



Metaphase

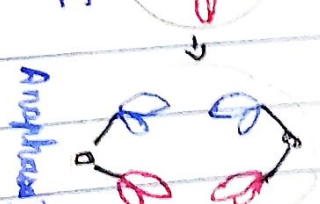
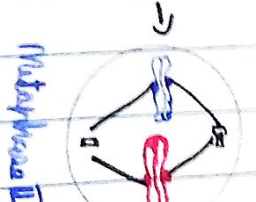
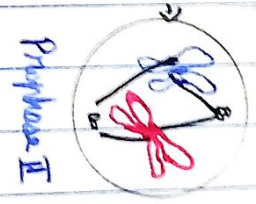
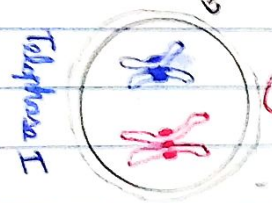
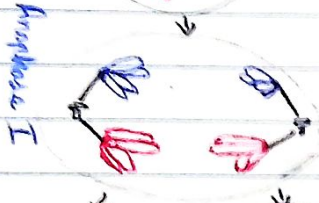
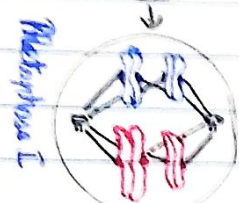
Anaphase

Telophase

# Stages Meiosis

Stages of Meiosis I

Stages of Meiosis II



# Meiosis

## Meiosis I

- Prophase I: longer and more complex compared to Mitosis

- Leptotene stage: chromosome become visible under light microscope. Compression of chromosome structure

- Zygotene: chromosome starts pairing - process: synapsis accompanied by the formation of synaptonemal complex. Homologous chromosomes are formed

- Pachytene: 4 chromatids of each bivalent becomes distinct and clearly appears as tetrads

\* Recombination process - Crossing over of genetic material between ~~sister~~ non-sister chromatids

- Diplotene: dissolution of synaptonemal & tendency of the recombined homologous chromosomes of bivalent to separate from each other except at the site of crossing over X shaped structure **chiasmata**.

\* Oocytes of some Vertebrates, diplotene can last for months to years

- Diakinesis: Terminalisation of Chiasmata

\* Chromosomes fully condensed

\* Meiotic spindle fibers assemble to separate

\* Nucleolus disappears

\* Nuclear envelope also breaks down

- Metaphase I: Bivalent chromosomes align in equatorial plate

\* Microtubules from the opposite poles of the spindle fibres attach to kinetochores

- Anaphase I : The homologous chromosome separate while sister chromatids remain associated at centromeres

- Telophase I : Nuclear membrane and Nucleolus reappears cytokinesis follows and this is called as **dyad** of cells

Interkinesis : Generally short ~~lived~~ lived. No DNA replication. Synthesis of protein & RNA, Reorganisation of Nuclear membrane. It is a short break to prepare for Meiosis II

## Meiosis II

- Prophase II : Nuclear membrane disappears chromosomes again become compact

- Metaphase II : chromosomes align at the equator and microtubules from opp poles of spindle get attached to kinetochores of sister chromatids

~~Ana~~ Anaphase II : \*splitting of the centromere of each chromosome which was holding sister chromatids together \*allowing them to move towards opp poles of the cell by shortening of microtubules attach to kinetochores

- Telophase II : 2 groups of chromosomes ~~no~~ once again get enclosed by a nuclear envelope cytokinesis follows resulting in the formation of tetrad of cells (i.e.) 4 haploid daughter cells

## ★ Significance of Meiosis

- \* Chromosome no is maintained in sexual reproduction
- \* Responsible for gamete formation
- \* Increases genetic variability from one generation to the next. Variations are important for evolution

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