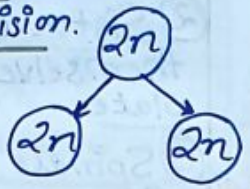
CELL CYCLE AND CELL DIVISION

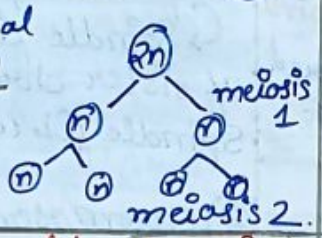
→ Growth → Mitosis
→ Repair
→ Reproduction → Meiosis.

Cell division is of 2 types →

① Mitosis → Equational division.
ploidy remain same.
no. of set of chromosome
2 daughter cells.



② Meiosis → Reductional division
→ ploidy → Half
→ 4 daughter cells



Mitosis → Term proposed by Flemming

Why does a cell divide?

① Kern Plasmic Ratio (Nucleo cytoplasmic Ratio) → Should be Constant (KI)
↳ Index

$$KI = \frac{V_{nucleus}}{V_{cell} - V_{nucleus}} = \frac{V_{nucleus}}{V_{cytoplasm}}$$

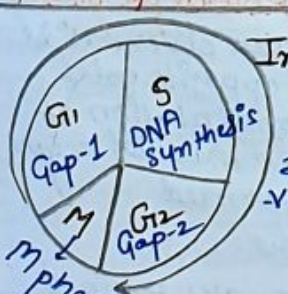
② Surface Volume Ratio →
Same Volume → More Surface area.
(Small Size Cell)

Cell Cycle → 95% Interphase (Growth and development)
Cell Cycle → M-phase (dividing phase) → 5%

Interphase → G1 Phase, Sphase, G2 phase

M-Phase → Karyokinesis (nuclear division), Cytokinesis (cytoplasmic division)

Most active phase of Cell Cycle is Interphase.



Interphase → phase b/w 2 successive M phase.

M phase → Cell Cycle

① Interphase → 95% time.
↳ G1 Phase (Gap-1 Phase) → pre DNA Synthesis phase →
① phase b/w division of cell (M phase) and DNA Synthesis (S phase).
② Longest phase of Interphase.
③ Cell is metabolically active / Protein synthesis / RNA Synthesis.
④ Cell Size ↑se, Kern plasmic ratio is disrupted.
⑤ Duplication and growth of Cell organelles occur in G1 phase.

S phase → DNA Synthesis Phase.
(phase b/w G1 and G2)
① 2nd largest phase of Interphase
② DNA replication in Nucleus.
③ Duplication of centriole in cytoplasm of animal cell.
④ Synthesis of Histone protein (Required for packing of DNA)
⑤ Amount of DNA doubles, but number of chromosome remains same.

G2 Phase → (Gap2 phase)
① Smallest phase of Interphase.
② Final phase for preparation before M phase.
③ RNA and protein Synthesis.
(Tubulin protein) → Required during formation of spindle apparatus.
④ Cell Growth will Continue.

G0 Phase → Quiscent Phase → Resting phase →
① Cell remains metabolically active.
② Cell exit the G1 phase and enters into resting G0 phase.
③ These Cells will not divide.
eg. → Heart Cell, Nerve Cell.
④ Cell can re-enter G1-phase for division

Avg Cell Cycle = 24 hours.
Yeast Cell Cycle = 90 minutes.

Checkpoints →

G1 Phase → Cyclin (degrade) → Mitotic Promoting Factor → G1-S checkpoint ✗ absent.

Late S phase → Cyclin bind with Kinase → G2 Phase

Cyclindependent Kinase → Mitoting promoting factor → M phase

G2-M checkpoint ↓ Triggered by MPF.

M-Phase (Division Phase)

→ KaryoKinesis (Nuclear division)
→ CytoKinesis (Cytoplasmic division)

KaryoKinesis → Prophase, Metaphase, Anaphase, Telophase

M phase → Most dramatic phase of cell cycle

Prophase → longest phase of Karyo-Kinesis

① Disintegration of nuclear membrane.
② Nucleolus dissapear.
③ Cell organelles like ER, Golgi Complex etc. also dissapear
④ Condensation of chromatin fibres to form chromosomes.
⑤ Chromosomes become distinct and untangled.
⑥ Centriole starts moving towards opposite poles. Astral rays are formed (Animal cells)

* Animal cell → Centriole → Astral mitosis.
* Plant Cell → anastral / amphiastral mitosis.

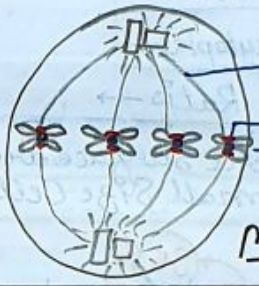
→ prophase

Metaphase →

Complete disintegration of nuclear envelop marks begining of Metaphase.

① Centriole reaches opposite poles.
② Sister Chromatids arrange themselves into an equitorial plate.
③ Spindle apparatus is formed.
↳ Spindle fibres Joins Kinetochore of sister chromatids.
Spindle fibres → microtubule / tubulin protein
④ Chromosome in metaphase is highly Coiled Short and distinct.

Best phase to study the morphology of chromosome. ★
* Spindle fibre attaches to Kinetochore of Sister Chromatids.



→ spindle fibres
→ Kineto-chores
→ equitorial plate / metaphasic plate

Metaphase

Anaphase → Shortest phase of the cell cycle. ★

① Division of Centromere
② Shortening of spindle fibres
③ Daughter chromatids start moving towards opposite poles.
④ Movement of daughter chromatid towards opposite is guided by centromere ★

Best phase to study Anatomy of Chromosome ★

anaphase

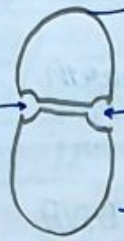
Telophase → Reverse prophase

① Daughter chromatids reaches opposite poles and decondensation of chromatin material occurs
② Nuclear envelope formed
③ Nucleolus reappears
④ ER / Golgi Complex etc.. are formed
⑤ Centriole dissapear

Chromosome lost individuality

Cytokinesis →

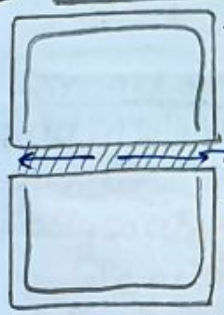
① In Animal Cells →



→ Centripetal Order.

↳ leads to formation of 2 daughter cells

② In Plant Cells →



→ Cell plate formation (occur by Golgi complex) phragmoplast.

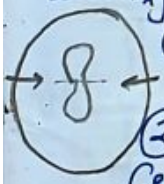
→ Centrifugal Order.

*In some Organisms, Karyokines is not followed by Cytokinesis, leading to a multinucleate structure (Syncytium) e.g. → liq. endosperm of Coconut.

Amitosis → Simple method of Cell division.

↳ no differentiation of chromosome and spindle.

→ Nuclear membrane does not dis-integrate.



① Constriction and elongation of nucleus to form daughter nuclii.

② Centripetal Constriction of Cell membrane to form 2 daughter cells.

Mitotic Poison - Colchini → Inhibits formation of Spindle fibres. ★

Meiosis → Term By Farmer and Moore

Meiosis-I	Meiosis II
→ prophase-I	Prophase-II
Metaphase-I	Metaphase-II
Anaphase-I	Anaphase-II
Telophase-I	Telophase-II

→ Reductional Division

Chromosome →

Human Body → 23 pairs of Chromosome.

22+X 22+Y

44+XY

1 Chromosome – ♀
1 Chromosome – ♂

Both of them are structurally similar, functionally different.

↓ Homologous Chromosome

1 Homologous Chromosome →

2 Chromose, 4 Chromatid, 2 Centromere, 4 Kinetochores.

Meiosis → 1 → Prophase 1 → Leptotene, Zygotene, Pachytene, Diplotene, Diakinesis

Leptotene ⟶ Diakinesis

① Centrosome starts moving towards oppo. poles.

② Nuclear membrane disintegrate.

③ Nucleolus dissappear.

④ ER, Golgi Complex disappear

① Leptotene → Chromatin material condense to form chromosome. Chromosome is long and thin and can be observed under light microscope. ★

Bouquet State (All chromosome in nucleus remains directed towards centriole)

② Zygotene → Pairing of homologous chromosome. → Synapsis → Synaptonemal Complex.

↳ Bivalent or tetrad formation occurs.

2 Chromosome, 4 Chromatid, 2 Centromere, 2 Kinetochore.

③ Pachytene → Bivalent is clearly visible.

→ Crossing over b/w non sister chromatids of Homologous Chromosome.

→ Formation of re-combination nodule

→ Enzyme used is re-combinase. ★

④ Diplotene → Chromosome only attached at site of crossing over.

↳ Dissolution of Synaptonemal complex

→ Chiasmata (X shaped structure) is formed at site of crossing over

→ Oocytes of Vertebrates arrested in diplotene phase. ★

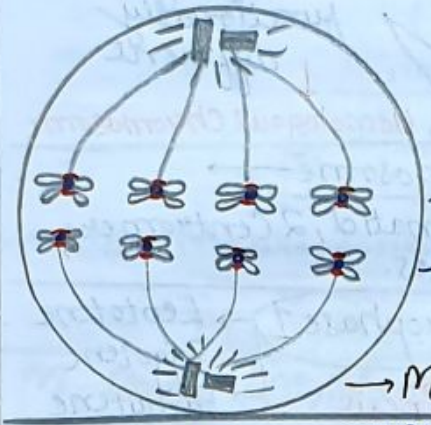
⑤ Diakinesis →

→ Terminalization of Chiasmata

→ Chromosome fully condense

→ Diakinesis represent transition to metaphase.

Metaphase-I → Bivalent aligns themselves onto double metaphasic plate.
→ Microtubules from opposite poles attaches to pair of homologous chromosome with one Kinetochore for each chromosome.



Double metaphasic plate

→ Metaphase-I

Anaphase-I → Division | Splitting of Centromere is absent.
↳ Due to shortening of Kinetochore, the homologous chromosome start moving towards opposite poles.
→ Sister Chromatids remains associated at their centromeres.
→ Anaphase-I is characterized by disjunction of chromosomes.

Telophase-1 → nuclear membrane and nucleolus reappear.
↳ Chromosome reaches opposik poles.

CytoKinesis-I is followed after TelophaseI
↳ ploidy-Half
↳ Become dyad of Cells

Meiosis I → Meiosis II
↓
InterKinase → G1 phase
→ S phase (Replication of DNA and synthesis of Histone protein does not occur)
→ G2 phase

Meiosis-II → Same as Mitosis
1. Prophase-II
2. Metaphase II – Single equitorial plate
3. Anaphase II – Splitting of Chromosome.
↳ Daughter chromatid move towards opposite poles
4. Telophase-II – Reverse prophase
↳ 4 Haploid Cells / Tetrad of Cells

After Meiosis-II →
↳ no. of Chromosome = $\frac{n}{2}$ (Half)
↳ Amount of DNA = $\frac{n}{4}$ (one fourth)

*Mitosis →

Amount of DNA double?
↳ G2 phase

NEET SLAYER