FREE NOTES · NCERT + NEET LEVEL

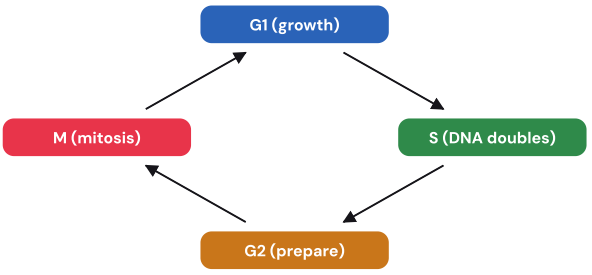
Cell Cycle & Cell Division

Phases of the cell cycle, G0, mitosis stages, cytokinesis, significance of mitosis, meiosis I and II with prophase I substages, and significance of meiosis.

01 The cell cycle
02 Mitosis (equational division)
03 Significance of mitosis
04 Meiosis I: prophase I
05 Rest of meiosis I and meiosis II
06 Significance of meiosis
07 Extra + tricks
08 Important Q&A
09 Common mistakes
10 Practice (NEET style)
11 Quick revision

01 The cell cycle

- Human cell divides about once every 24 hours; yeast in ~90 min.
- **Interphase** (>95% of time): **G1** (growth, metabolically active), **S** (DNA doubles from 2C to 4C; chromosome number unchanged; centriole duplicates in cytoplasm), **G2** (proteins for mitosis).
- **M phase**: karyokinesis + cytokinesis.
- **G0** (quiescent stage): cells exit G1 and stop dividing (e.g. heart cells) but remain metabolically active.



Phases of the cell cycle

02 Mitosis (equational division)

Stage	Key events
Prophase	Chromatin condenses; two chromatids joined at centromere; centrioles move to poles, asters form; Golgi, ER, nucleolus, nuclear envelope disappear (end)
Metaphase	Chromosomes most condensed (best stage to study morphology); align at **metaphase plate**; spindle fibres attach to kinetochores
Anaphase	Centromeres split; chromatids (daughter chromosomes) move to opposite poles
Telophase	Chromosomes decondense at poles; nuclear envelope, nucleolus, Golgi, ER re-form

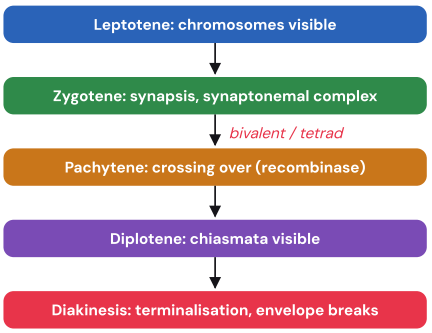
Cytokinesis: animal cells by furrow (cleavage) in membrane; plant cells by **cell plate** (middle lamella) formed from centre outward. Karyokinesis without cytokinesis ⇒ syncytium (liquid endosperm of coconut).

03 Significance of mitosis

- Daughter cells identical to parent (same chromosome number) ⇒ growth of multicellular organisms.
- Restores nucleo-cytoplasmic ratio.
- Cell repair: upper layer of epidermis, gut lining, blood cells replaced.
- Meristems (apical, lateral cambium) grow continuously by mitosis.
- Usually in diploid cells, but haploid cells also divide by mitosis in some lower plants and social insects (male honey bees).

04 Meiosis I: prophase I

- Meiosis: one DNA replication, two divisions ⇒ 4 haploid cells. Occurs during gamete formation.
- Prophase I is long and has 5 substages (right).
- Synaptonemal complex forms in zygotene and dissolves in diplotene.
- Crossing over (exchange between non-sister chromatids of homologous chromosomes) in pachytene, enzyme **recombinase**.
- In some vertebrate oocytes diplotene lasts months or years.



Substages of prophase I

05 Rest of meiosis I and meiosis II

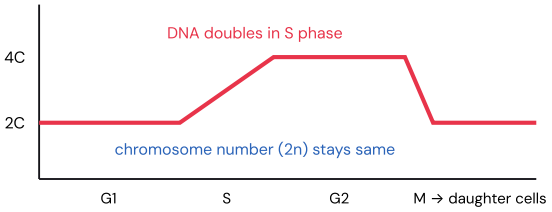
Stage	Meiosis I (reductional)	Meiosis II (equational, like mitosis)
Metaphase	Bivalents align on equatorial plate	Chromosomes align; spindle to kinetochores of sister chromatids
Anaphase	Homologous chromosomes separate; sister chromatids stay together	Centromeres split; sister chromatids separate
Telophase	Two haploid cells (dyad); interkinesis follows (no DNA replication)	Four haploid cells (tetrad)

06 Significance of meiosis

- Keeps chromosome number constant across generations in sexually reproducing organisms (halves it, fertilisation restores).
- Increases **genetic variability** via crossing over and independent assortment; variation is the raw material for evolution.
- Mitosis vs meiosis: 2 vs 4 daughter cells; identical vs genetically different; somatic vs reproductive cells.

07 Extra + tricks

Stage	Chromosomes	DNA
G1	2n	2C
After S, G2	2n	4C
Mitosis daughter	2n	2C
After meiosis I	n	2C
After meiosis II	n	C



DNA content through the cell cycle

- **Amitosis**: direct division without spindle (some protozoa, cartilage cells). **Endomitosis**: chromosomes duplicate without nuclear division ⇒ polyploidy.
- Mitosis trick **PMAT**; meiosis I separates homologues, meiosis II separates sisters.
- Crossing over gives **recombinants**; independent assortment gives 2^n gamete types (n = pairs).

08 Important Q&A

Q1. A cell has 2C DNA in G1. What is the DNA content in G2 and after meiosis I?

G2: 4C. After meiosis I each cell: 2C (haploid number of chromosomes, each with 2 chromatids).

Q2. Which stage is best to study chromosome morphology and why?

Metaphase, because chromosomes are most condensed and lie on the metaphase plate.

Q3. Name the stage of crossing over and the enzyme.

Pachytene; recombinase.

09 Common mistakes

- Thinking chromosome number doubles in S phase (only DNA doubles).
- Putting chiasmata in pachytene (they become visible in diplotene).
- Saying sister chromatids separate in anaphase I (homologues separate).
- Saying DNA replicates during interkinesis.

10 Practice (NEET style)

1. Stage where cells exit the cycle?
2. Synaptonemal complex forms in?
3. Cell plate is found in?
4. Number of cells after meiosis?
5. Terminalisation of chiasmata?

ANSWERS

1) G0 · 2) Zygotene · 3) Plant cell cytokinesis · 4) 4 haploid · 5) Diakinesis

11 Quick revision: 5 minutes before the exam

INTERPHASE

- G1 → S (DNA 2C→4C) → G2
- G0 quiescent

MITOSIS

- Metaphase plate
- Anaphase: centromere splits
- Plant: cell plate

PROPHASE I

- L-Z-P-D-D: Lazy Zebras Prefer Dark Days
- Pachytene crossing over

MEIOSIS

- I reductional, II equational
- 4 haploid, variation

Have a doubt? Ask the AI Doubt Solver at padhaiadda.netlify.app, or take the mock test on this chapter.