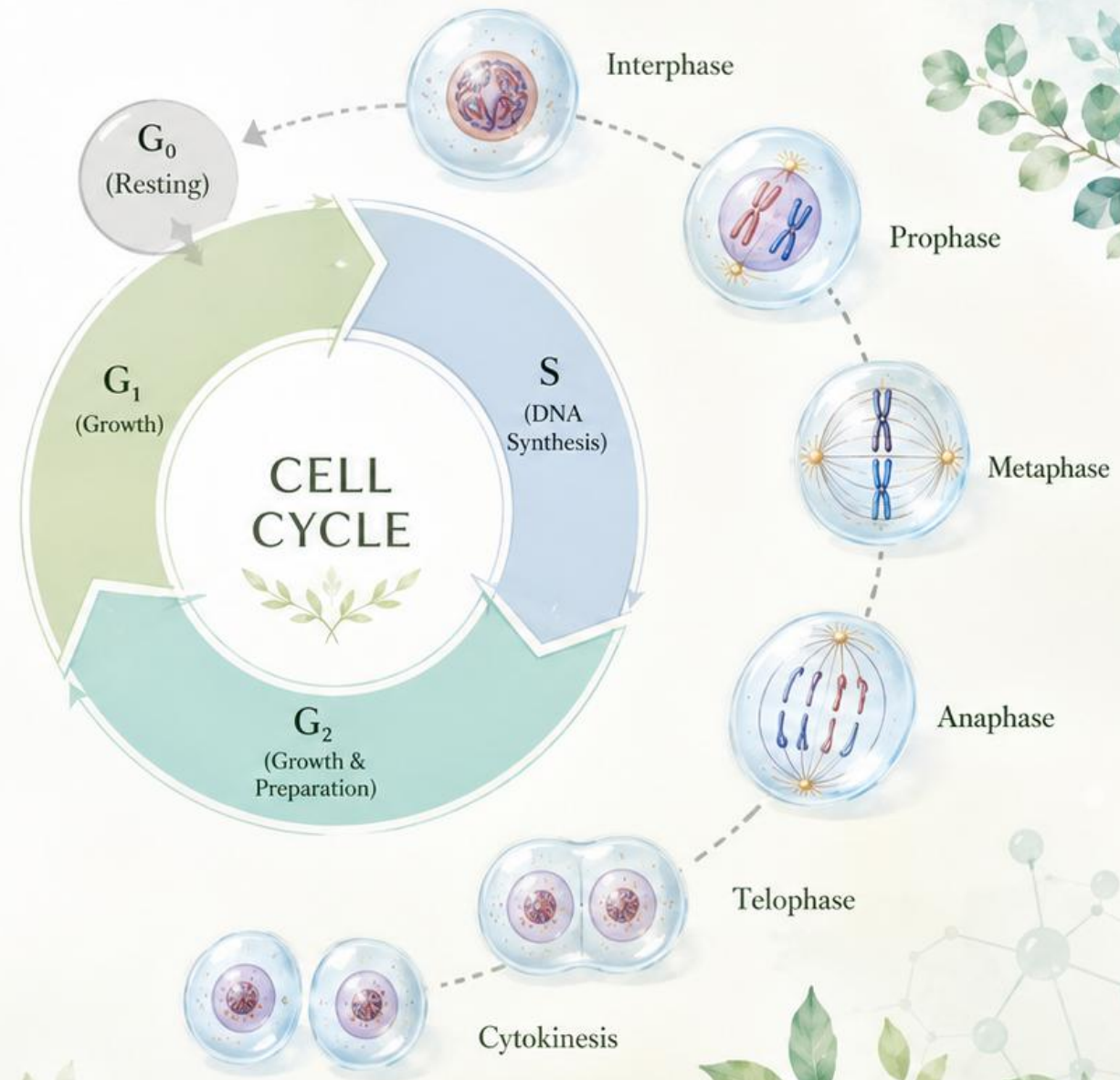


Chapter 10 : Cell Cycle and Cell Division

Biology Notes | Class 11



CELL CYCLE: COORDINATED GROWTH & DIVISION

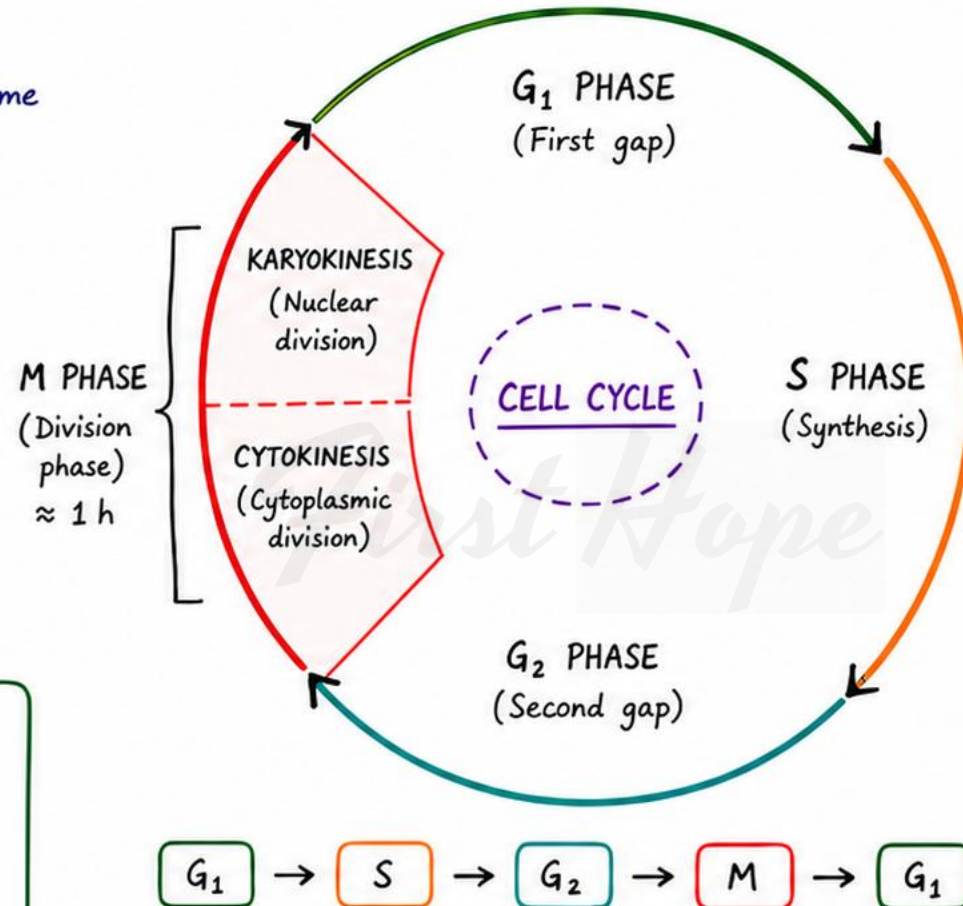
DEFINITION:

Cell cycle is the ordered sequence in which a cell grows, duplicates its genome and constituents, then divides into daughter cells.

- Cell growth is broadly continuous throughout the cycle, but DNA replication occurs only in S phase.
- All events are genetically regulated and coordinated to ensure accurate replication of DNA and its equal distribution, thereby preserving intact genomes in daughter cells.

INTERPHASE = $G_1 + S + G_2$

- Longest part of the cell cycle.
- Time of growth, normal metabolism and preparation for division.
- DNA replication occurs only in S phase.
- Centrosome duplicates (in animal cells) and other organelles increase in number.
- More than 95% of the cell-cycle duration is spent in interphase.



COORDINATED EVENTS

- Growth, DNA replication and division occur in an ordered sequence.
- Genetic control coordinates completion of each stage.
- Accurate chromosome distribution preserves intact genomes.

TIMING (REPRESENTATIVE):

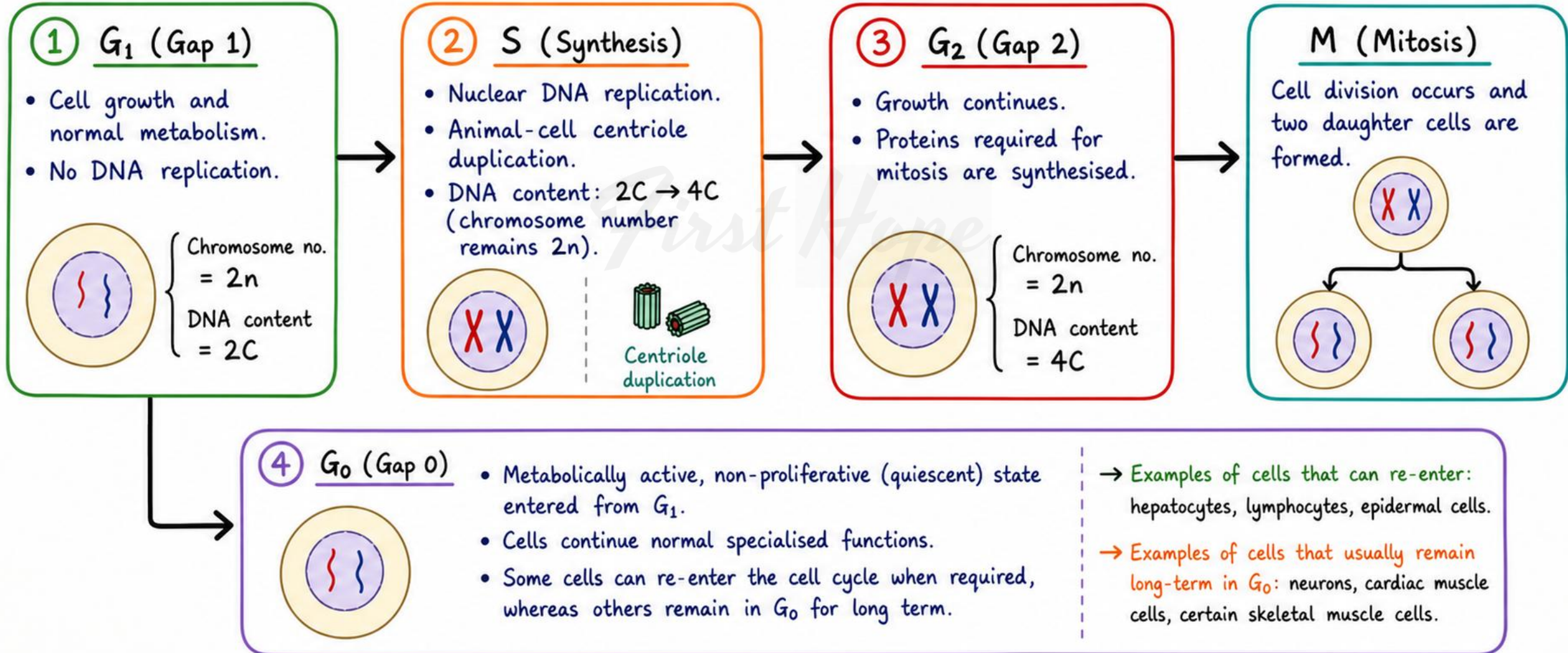
- In cultured human cells:
 - Total cell cycle ≈ 24 h
 - Division proper (M phase) ≈ 1 h
 - Interphase ($G_1 + S + G_2$) $> 95\%$ (≈ 23 h)
- In yeast (e.g., *Saccharomyces cerevisiae*):
Total cell cycle ≈ 90 min (≈ 1.5 h)
- Duration of the cell cycle varies widely with organism, cell type and environmental conditions.

M PHASE (DIVISION PHASE)

- Shortest part of the cell cycle.
- Consists of two events:
 - ① KARYOKINESIS (Nuclear division)
 - ② CYTOKINESIS (Cytoplasmic division)
- Usually produces two genetically similar daughter cells with the same chromosome number.

INTERPHASE: G_1 , S, G_2 & G_0

Interphase is the metabolically active phase of the cell cycle in which the cell grows, carries out normal functions and prepares for cell division; it is not a true resting phase.



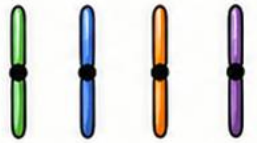
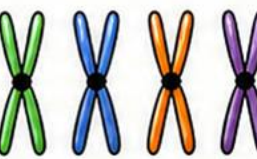
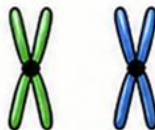
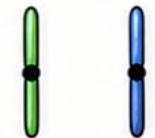
CHROMOSOME, CHROMATID & DNA COUNTS

DEFINITIONS

- Chromosome number is counted by CENTROMERES.
- Before replication, one chromosome has one chromatid.
- After S phase, one replicated chromosome has two sister chromatids but is still **ONE** chromosome.
- After separation, each chromatid is called a daughter chromosome.
- C means relative DNA content.

STAGE	CHROMOSOME NUMBER (counted by centromeres)	CHROMATID NUMBER	DNA CONTENT (relative) C
G ₁	4 chromosomes	4 chromatids	2C
AFTER S / G ₂ / MITOTIC METAPHASE	4 chromosomes	8 chromatids	4C
AFTER MITOSIS, PER DAUGHTER CELL	4 chromosomes	4 chromatids	2C
AFTER MEIOSIS I, PER DAUGHTER CELL	2 chromosomes	4 chromatids	2C
AFTER MEIOSIS II, PER DAUGHTER CELL	2 chromosomes	2 chromatids	1C

VISUAL COUNT-CHECK (2n = 4)

G ₁		(four single rods)
AFTER S / G ₂ / MITOTIC METAPHASE		(four X-shaped replicated chromosomes)
AFTER MITOSIS, PER DAUGHTER CELL		(four single rods)
AFTER MEIOSIS I, PER DAUGHTER CELL		(two X-shaped chromosomes)
AFTER MEIOSIS II, PER DAUGHTER CELL		(two single rods)

At mitotic anaphase, separated chromatids become daughter chromosomes; each future nucleus receives 2n.

MITOSIS: OVERVIEW & PROPHASE

PROPHASE

METAPHASE

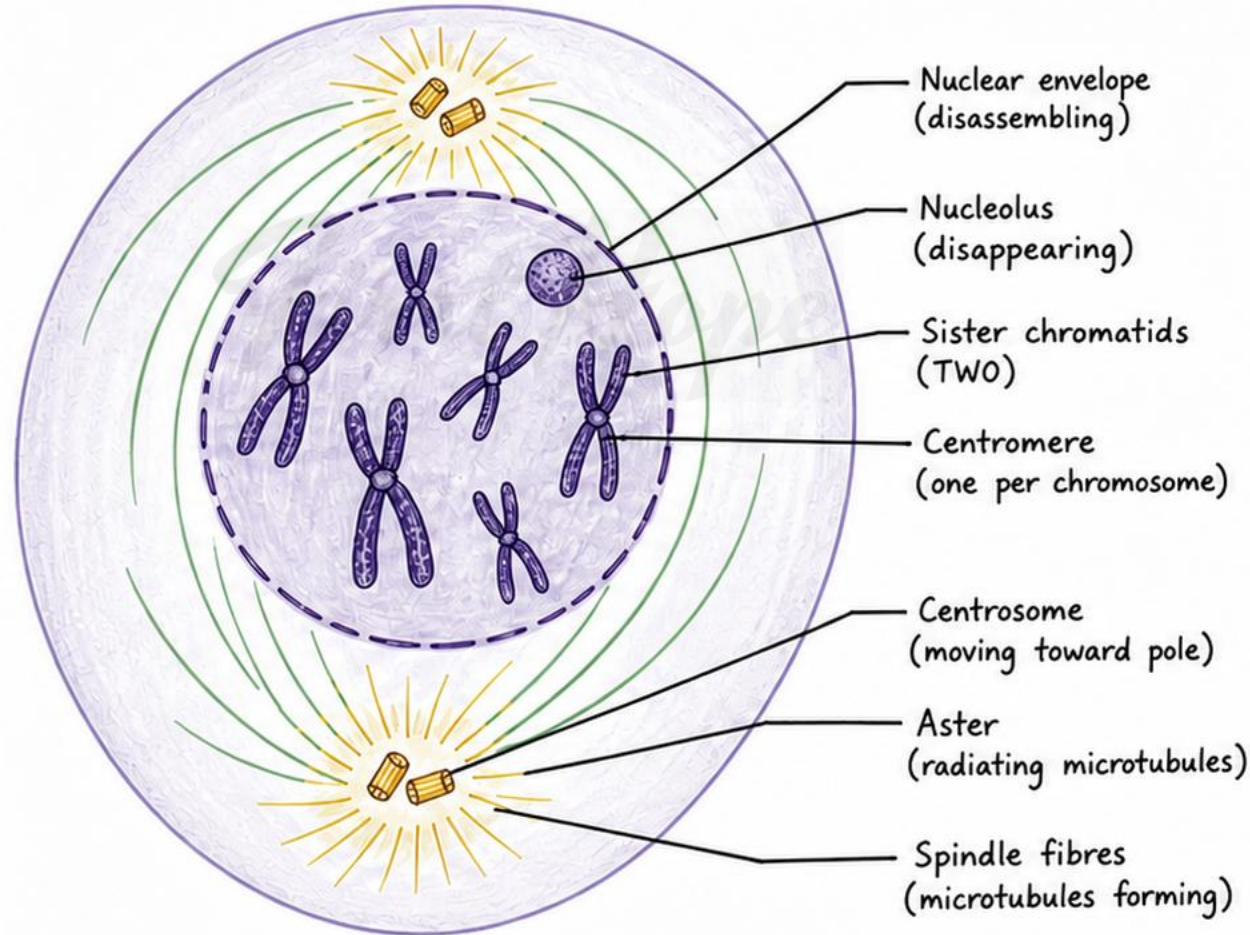
ANAPHASE

TELOPHASE

OVERVIEW

- Mitosis is an equational nuclear division that normally maintains chromosome number.
- Karyokinesis progresses continuously through four convenient stages, not sharply separated.
- Prophase follows S and G₂.
- Chromatin condenses into compact duplicated chromosomes; each visible chromosome has TWO sister chromatids joined at one centromere.
- Duplicated centrosomes move toward opposite poles; each radiates asters and spindle microtubules.
- By late prophase, nucleolus and nuclear envelope disappear/disassemble; Golgi and ER are no longer visibly organised.

PROPHASE (animal-cell schematic)



KEY EVENTS IN PROPHASE

- ① Chromatin condenses into compact duplicated chromosomes.
- ② Each visible chromosome has TWO sister chromatids joined at one centromere.
- ③ Duplicated centrosomes move toward opposite poles of the cell.
- ④ Each centrosome radiates asters and spindle microtubules (spindle begins to form).
- ⑤ By late prophase, nucleolus and nuclear envelope disappear/disassemble; Golgi and ER are no longer visibly organised.

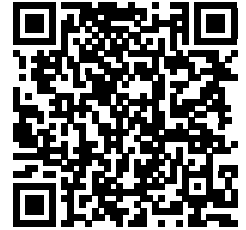


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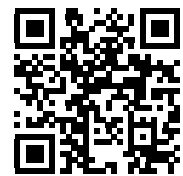


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