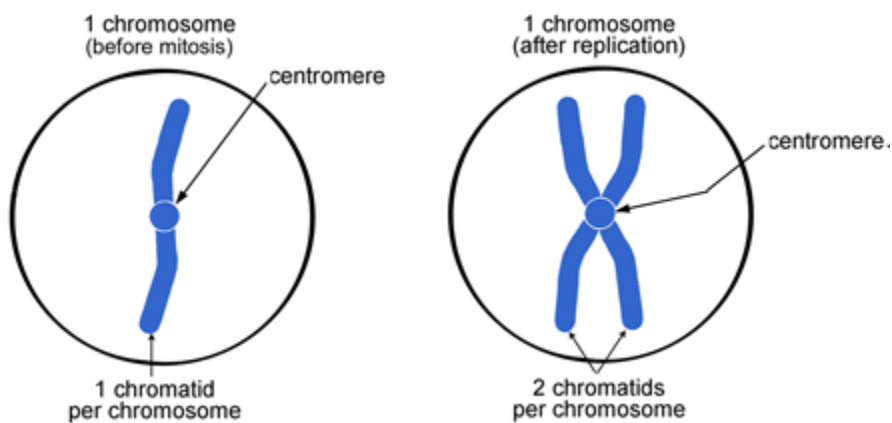
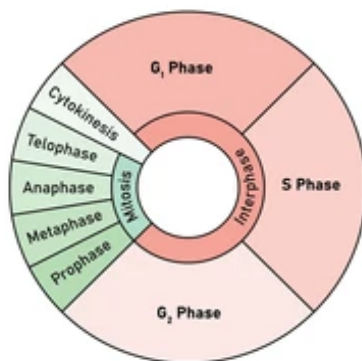


AS Biology 9700 • Mitotic Cell Cycle

Structure	Function
Chromosome	A thread like structure made of a DNA molecule wound around histone proteins
DNA	Contains genetic information in the form of genes
Histone proteins	DNA wraps around histones to help package and condense it
Sister chromatids	Two genetically identical copies of a chromosome produced during DNA replication
Centromere	Region joining the two sister chromatids; spindle fibres attach here via the kinetochore
Telomeres	Repetitive DNA sequences at chromosome ends that protect genes from being lost during DNA replication

Cell Cycle



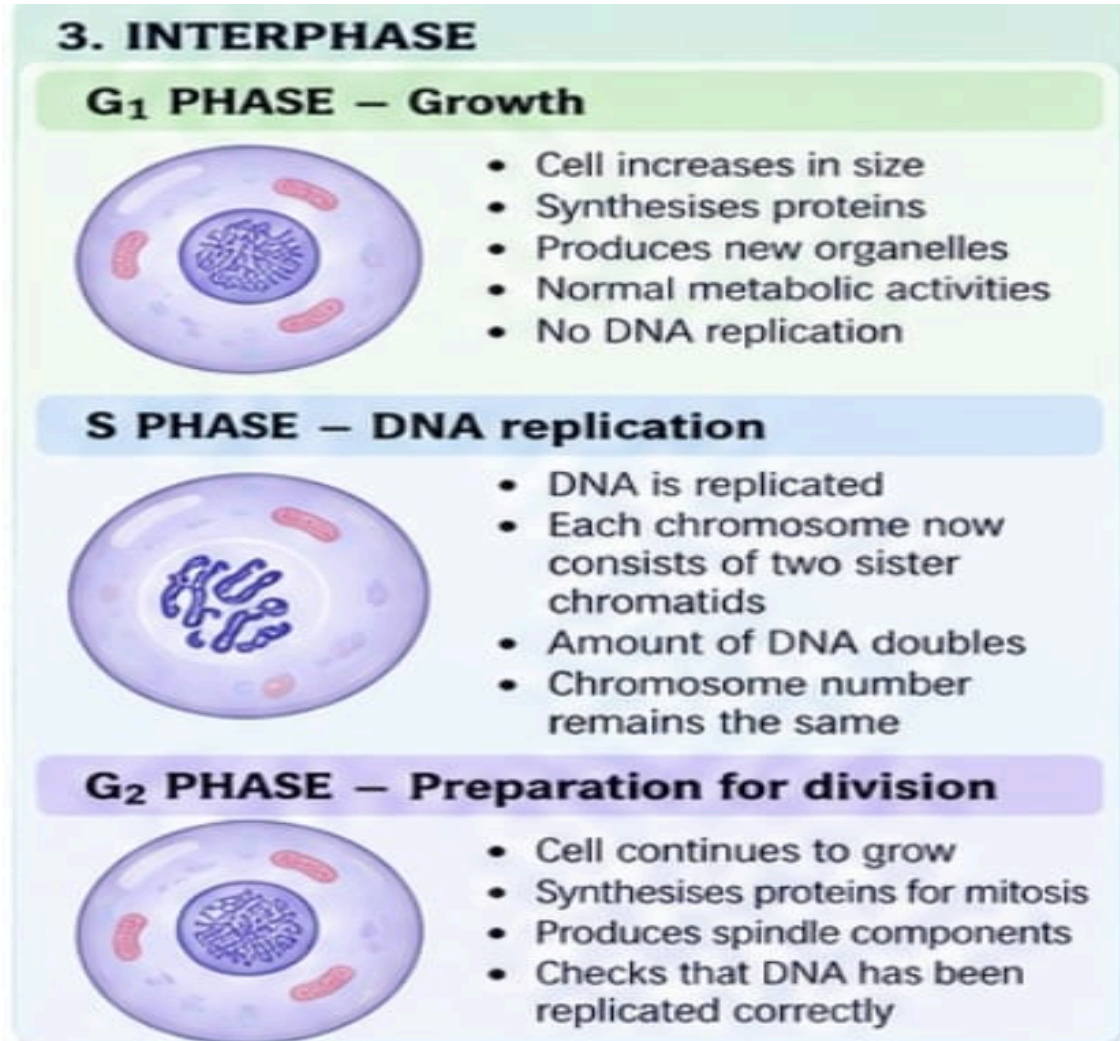
Before DNA replication: 46 chromosomes, 46 DNA molecules

- One chromosome = one chromatid (one DNA molecule)

After DNA replication: 46 chromosomes, 92 DNA molecules

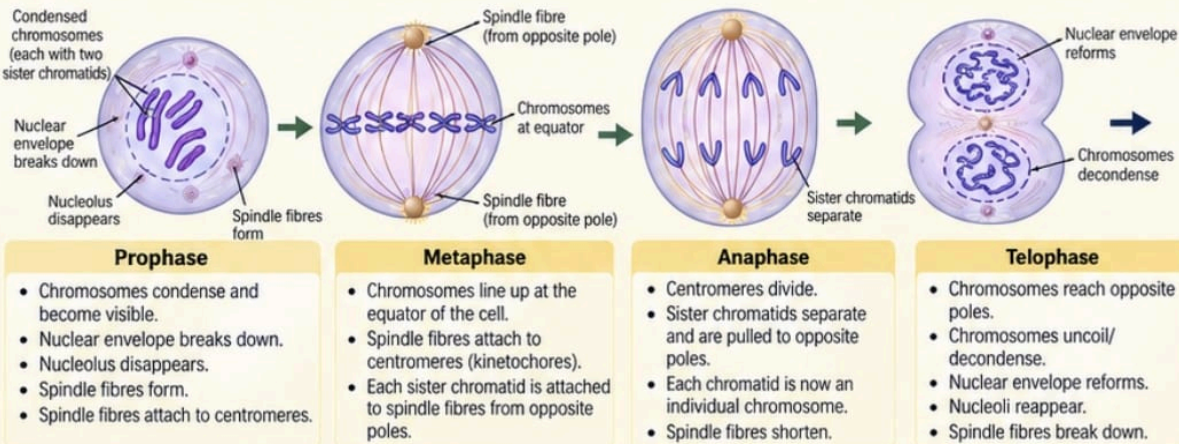
- One chromosome = two sister chromatids (they are joined at the centromere).

A replicated chromosome is still **ONE** chromosome, not two.

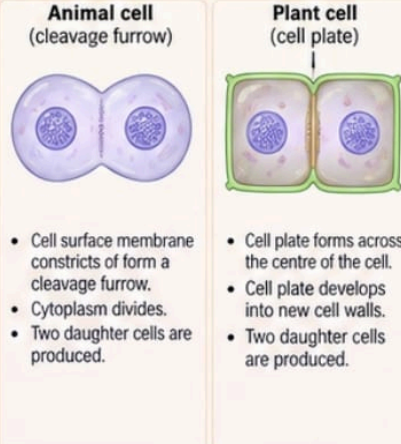


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4. MITOSIS (Nuclear Division)



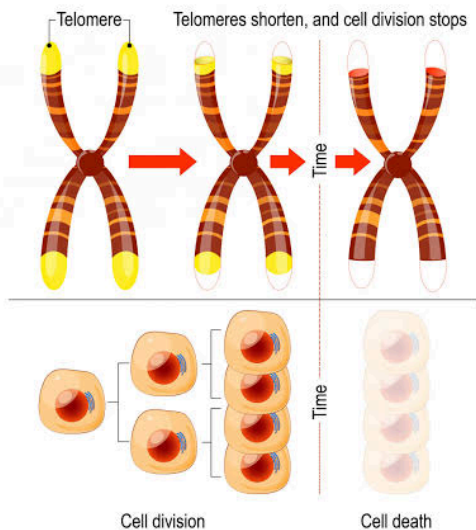
5. CYTOKINESIS (Cytoplasmic Division)



Importance of mitosis:

1. Growth of multicellular organisms
2. Replacement of dead cells
3. Replacement of damaged cells (**tissue repair**)
4. Asexual reproduction

Aging process



Telomeres

Telomeres are repetitive DNA sequences found at the ends of chromosomes.

They prevent the **loss of important genes** from the ends of chromosomes during DNA replication.

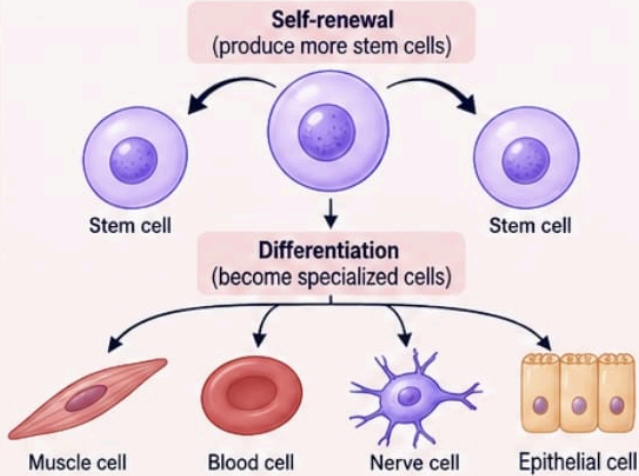
This is necessary because the ends of linear chromosomes cannot be completely replicated by DNA polymerase. (**End Replication Problem**)

The enzyme **telomerase** can **maintain/extend telomeres**. It is **particularly active in stem cells and cancer cells**.

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1. WHAT ARE STEM CELLS?

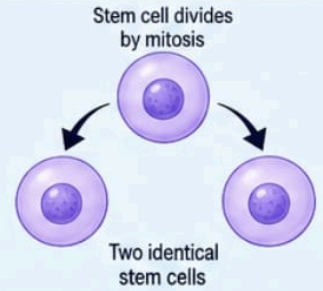
- Unspecialized cells that have the ability to:
 - self-renew** (divide and make more stem cells)
 - differentiate** (develop into specialized cell types)
- Found in early embryos, and also in certain tissues of the body (e.g. bone marrow, skin, gut).



2. KEY PROPERTIES

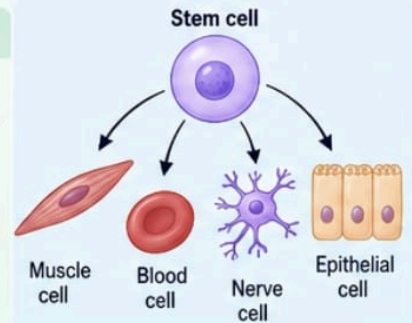
Self-renewal

- Can divide (by mitosis) to produce more stem cells.
- Allows a long-term supply of undifferentiated cells.
- Can continue for many years (some can divide throughout life).



Differentiation

- Can develop into specialized cells with specific structures and functions.
- Triggered by chemical signals and gene expression changes.
- Allows the formation of many different cell types in the body.

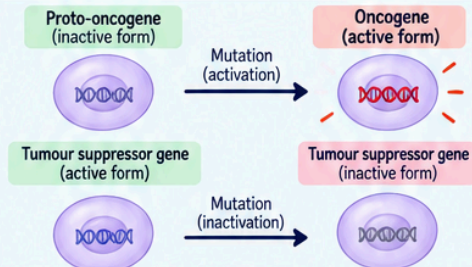


Formation of Tumour

Random changes in genes

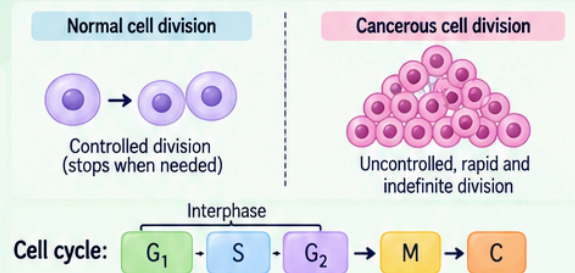
1 Mutation in the genes that control cell division

- **Proto-oncogene**: normally inactive in body cells, but becomes active due to mutation and can cause cancer.
- **Tumour suppressor gene**: normally active in body cells, but become inactive due to mutation, leading to tumour formation.



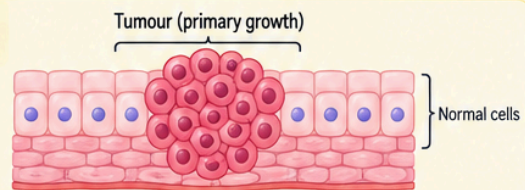
2 Uncontrolled mitosis

- Cells divide repeatedly and the cell cycle checkpoints are not controlled.
- Cells divide rapidly and indefinitely because **telomerase** becomes active.
- These cells have a shorter interphase (less time for growth and repair).



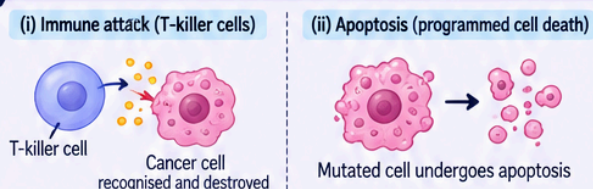
3 Formation of irregular mass (Primary growth)

- Repeated cell division leads to a mass of abnormal cells called a tumour.
- This is the **primary growth** at the original site.



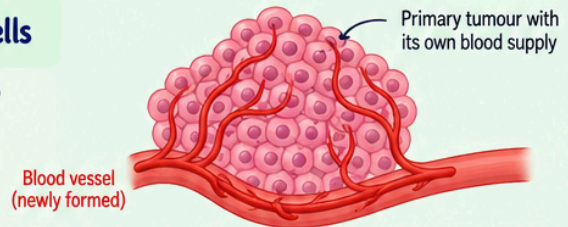
4 Removal of mutated cells by the body

- Mutated cells can be removed by:
 - (i) Immune attack (T-killer cells)
 - (ii) Apoptosis (programmed cell death)



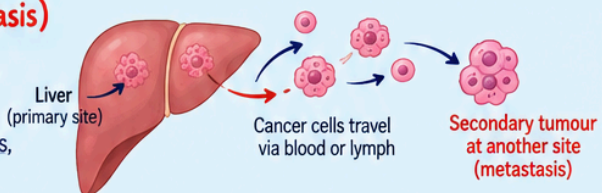
5 Survival and further growth of abnormal cells

- Some cancer cells escape immune attack and fail to undergo apoptosis.
- These cells develop their own blood supply (angiogenesis) and lymphatic system to obtain nutrients and oxygen.



6 Spread to other parts of the body (Metastasis)

- Cancerous cells may spread from the **primary site** to other parts of the body.
- They travel through the blood or lymph and grow at new sites, forming **secondary tumours**.



Mutation → uncontrolled division → tumour → spread to new sites (metastasis)

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