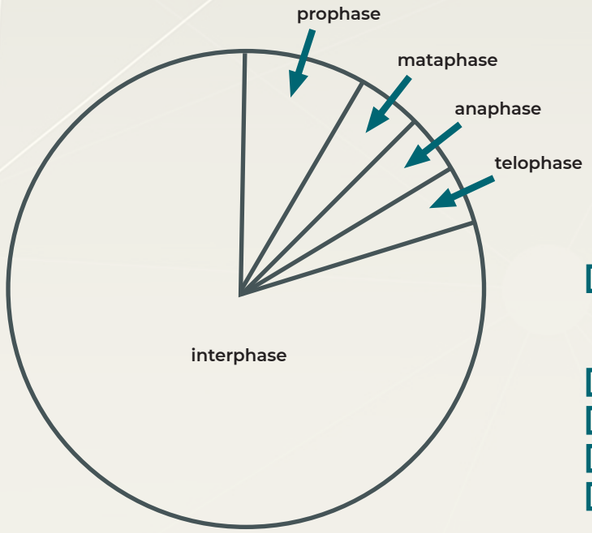
The cell cycle and cell division

Cell cycle



The cell cycle is a natural cycle of events that occur in the life of a cell.

During most of the cell cycle the cell remains in a phase called **interphase**.

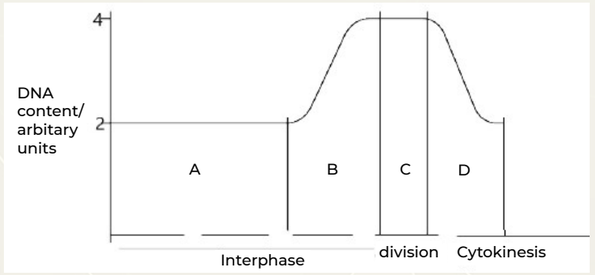
Interphase is a time of high metabolic activity for the cell:

During section A of the graph below, the following occur:

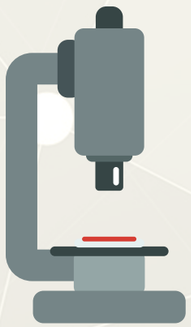
- **Replication** organelles like mitochondria and chloroplasts which have their own DNA.
- **Making** new organelles.
- **Synthesis** of ATP.
- Synthesis of proteins.
- Increase in cell size.

During section B:

- **Replication** of DNA.



IPMAT-can be used to remember the order of the phases in mitosis:



Cytokinesis

Where telophase is the division of the nucleus, cytokinesis is the division of the cytoplasm to create the 2 new genetically identical cells.

In plant cells there are some differences:

- There are **no centrioles** in plant cells.
- In cytokinesis, **a cell plate** (droplets of cell wall material) develops **from the centre out** instead of cleavage from the outside in as in animal cells.

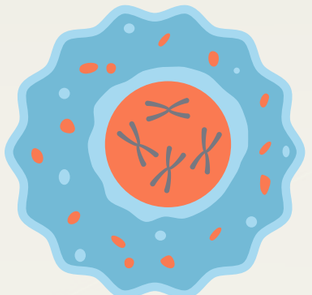
Mitosis

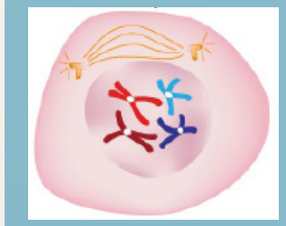
The significance of mitosis is that it produces cells which are genetically identical to the parent cell, giving genetic stability.

This is cell division for:

- growth
- epairing damaged cells
- replacement of old, worn out cells
- sexual reproduction.

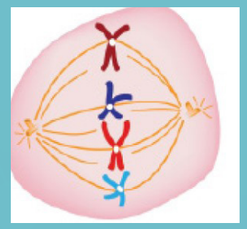
The cell cycle is controlled by genes. If the genes that regulate the cell cycle are damaged, uncontrolled mitosis can occur. This rapid replication of cells can form tumours, leading to a disease called cancer. These genes that cause cancer are called **oncogenes**.





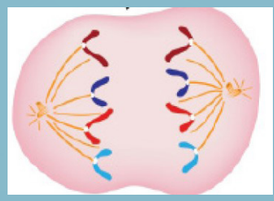
Prophase

- Chromosomes condense and become visible
- Centrioles move to opposite sides of cell
- Spindle forms from microtubules
- Nuclear envelope disintegrates.



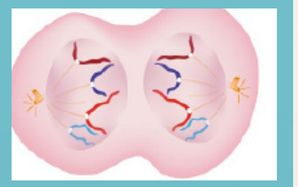
Metaphase

- Centromeres of chromosomes attach to spindle and line up on the equator.



Anaphase

- Spindle fibres shorten
- Centromere separates and individual chromatids are pulled to the pole's centromere first.



Telophase

- Spindle breaks down
- Chromosomes uncoil
- Nuclear envelope reforms.

The cell cycle and cell division

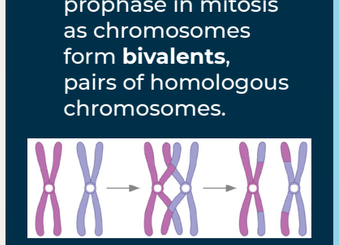
Meiosis

This takes place in reproductive organs and the significance of this process is that it produces cells which are haploid for sexual reproduction.

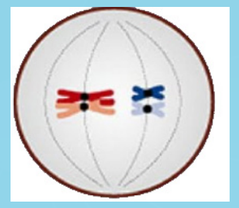
Meiosis occurs in 2 different cell division events following interphase. The first division is different to the phases in mitosis.

Prophase I

- Differs from prophase in mitosis as chromosomes form **bivalents**, pairs of homologous chromosomes.

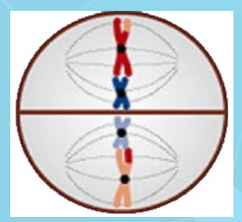


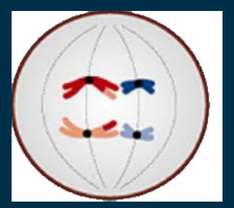
- Arms of the chromatids may cross over forming **chiasmata** where genetic material can be exchanged between homologous chromosomes increasing the variation in inherited genomes.



Metaphase I

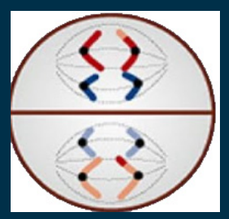
- **Homologous chromosomes** arrange themselves in pairs along the equator.
- **Independent assortment** occurs here where the homologous chromosomes from parent 1 and parent 2 arrange themselves randomly along the spindle facing each pole.





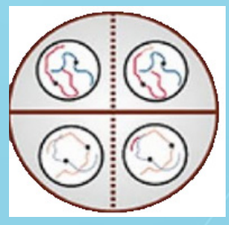
Anaphase I

- The chromosome bivalents separate as each chromosome is pulled by its centromere (which does not split) towards the opposite pole.



Telophase I

- Nuclear envelopes reform around the chromosomes at the poles.
- In meiosis prophase II occurs after telophase I.



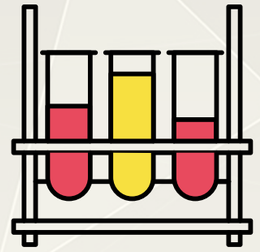
Prophase II

Metaphase II

Anaphase II

Telophase II

Events occur in each new nucleus in the second phase of meiosis exactly as they do in mitosis. Finally, cytokinesis occurs resulting in 4 genetically varied cells.



Comparing mitosis and meiosis

	Mitosis	Meiosis
number of nuclear divisions in the process	1	2
number of cells formed	2	4
ploidy of parental cells/nuclei	2n- Diploid	2n- Diploid
ploidy of daughter cells/nuclei	2n- Diploid	n- Haploid
genetic nature of daughter cells/nuclei	Genetically identical	Genetically different
pairing of homologous chromosomes	No	Yes - to form bivalents
crossing over	No	Yes - Chiasmata formed
segregation of homologous chromosomes.	No	Yes - bivalents separate.