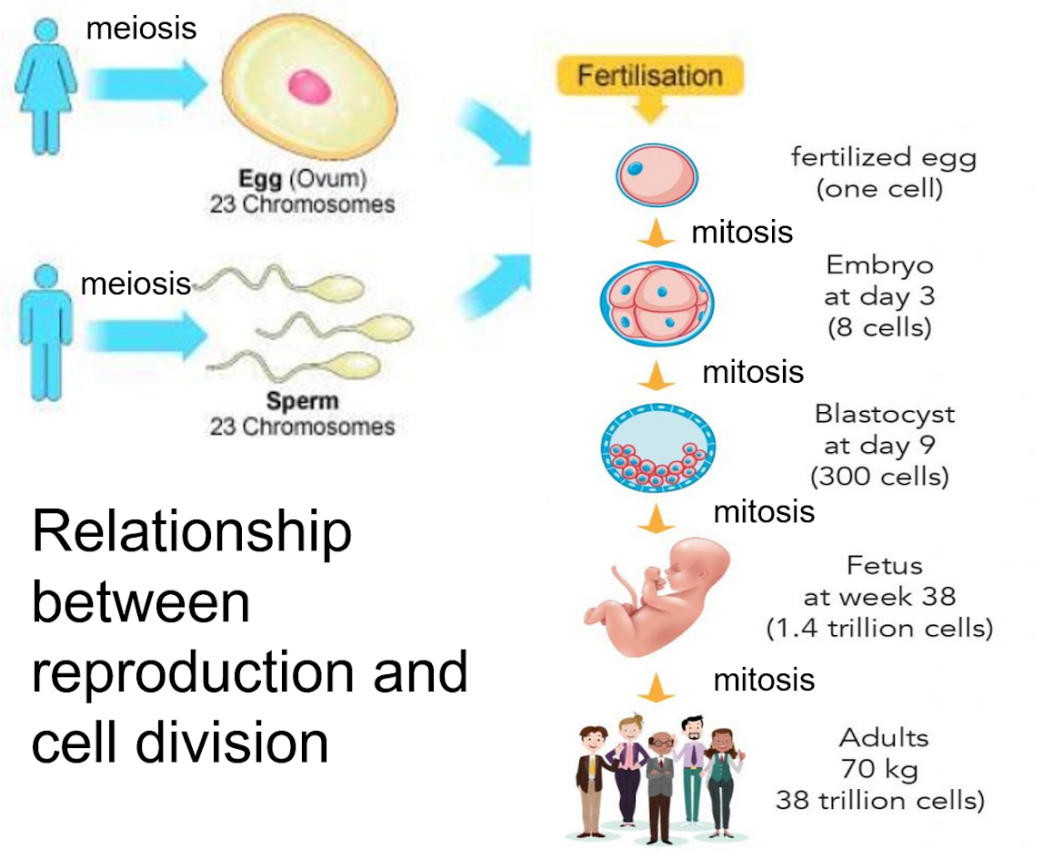
Relationship between reproduction, mitosis and meiosis



LO: State the importance of mitosis in growth, repair and asexual reproduction

- For growth of an organism by producing new cells
- For repair of worn-out parts of body
- For asexual reproduction
    - Example: Storage organs in plants can develop roots and shoots by mitosis.

LO: Explain the need for the production of genetically identical cells

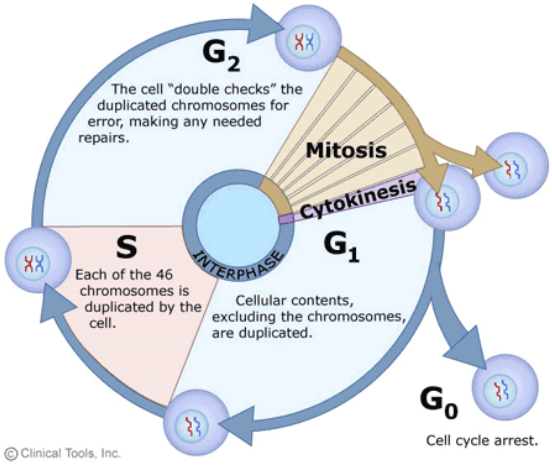
- To ensure all the genes are correctly copied and passed down to future offspring.
- To produce genetically stable daughter cells which contain all the genes needed for subsequent cell division and differentiation.
- To prevent uncontrolled cell division.

LO: Identify, with the aid of diagrams, the main stages of mitosis

Cell cycle

Stages of cell cycle:

1. Interphase (DNA replication)
2. Mitosis/ Meiosis (PMAT)
3. Cytokinesis (Cleavage of cytoplasm)



Stages of mitosis

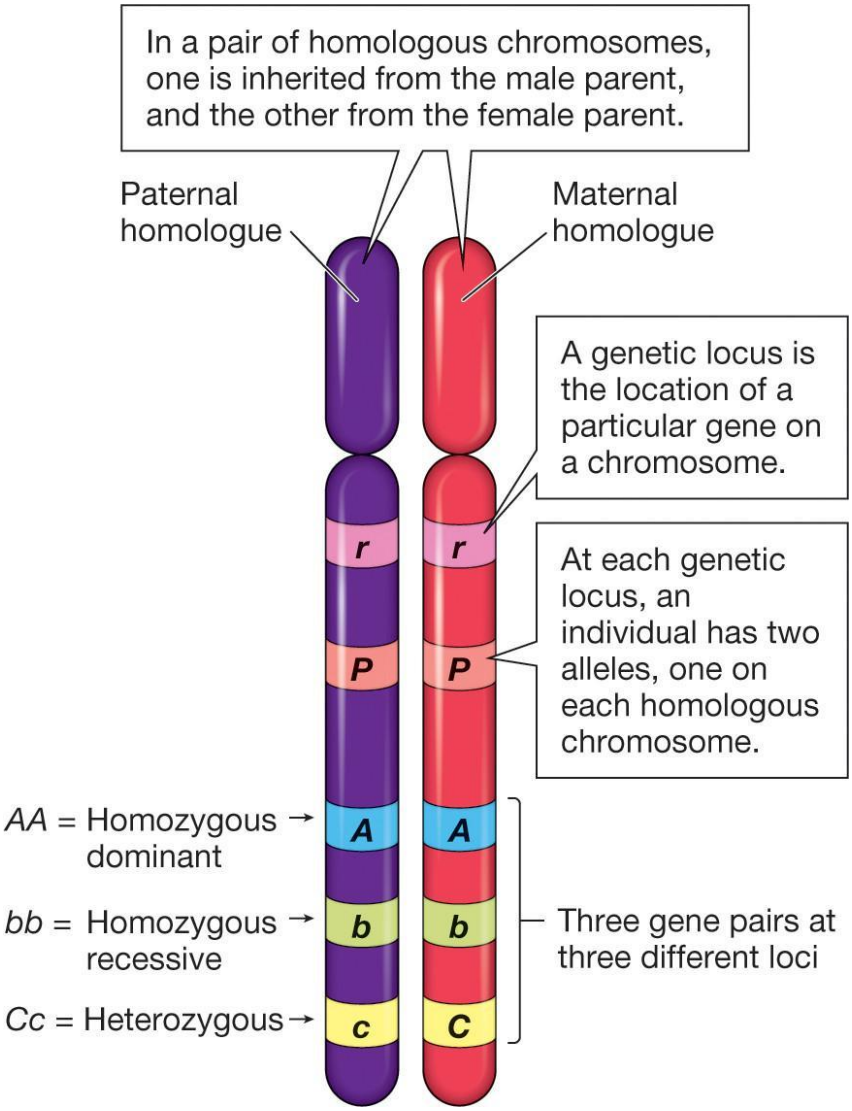
Prophase - Chromatin threads condense, coil and shorten to form chromosomes, spindle fibre forms and nucleolus and nuclear membrane disappears

Metaphase - Chromosomes line up singly along the equator of the cell attached to the spindle fibre at the centromere

Anaphase - Centromeres split and sister chromatids separate to form daughter chromosomes which are pulled to opposite poles of the cell

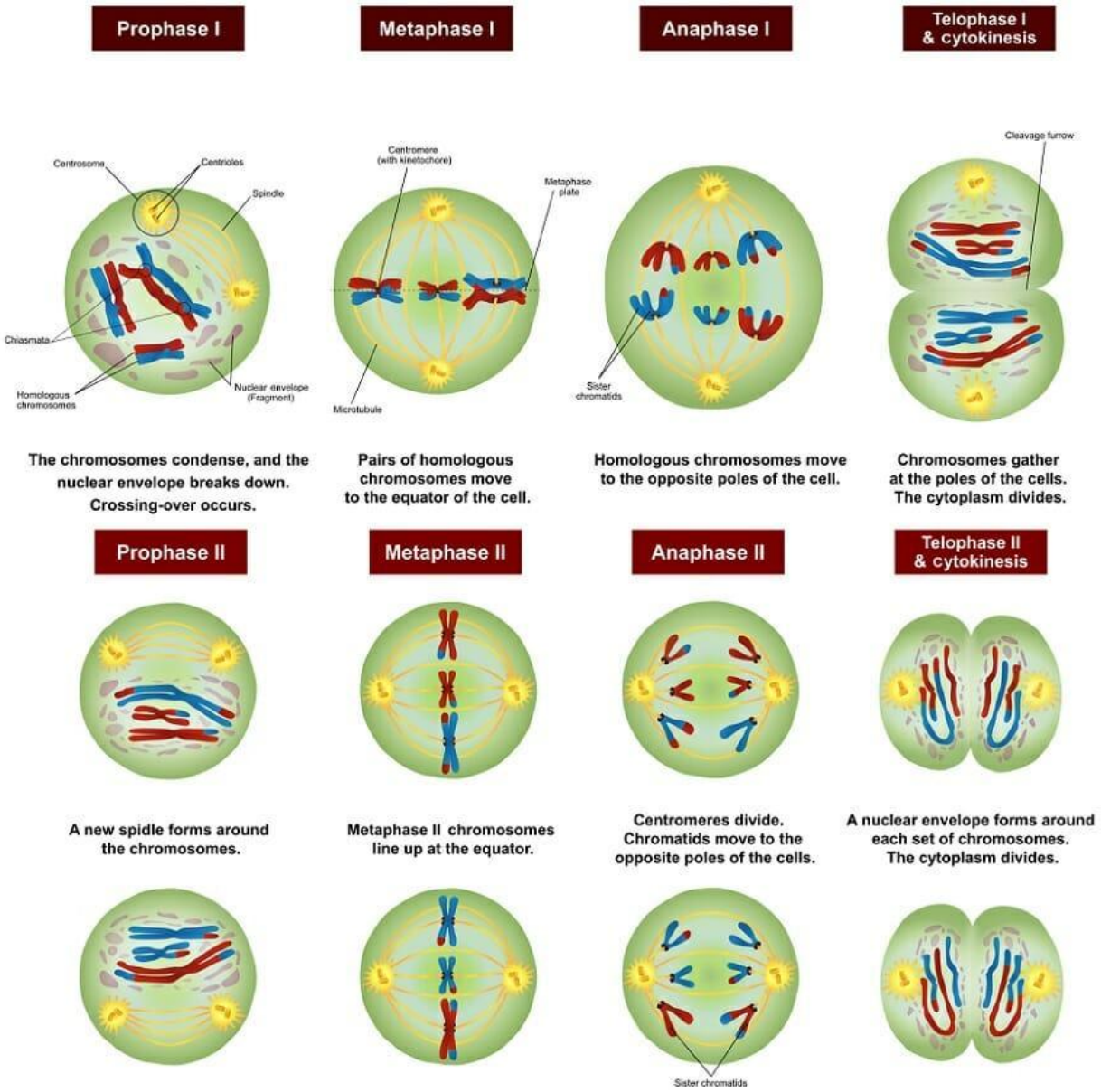
Telophase - Nuclear envelop and nucleolus reforms, spindle fibre disintegrate, chromosomes uncoil back to chromatin threads and cleavage furrow forms, followed by the division of cytoplasm (cytokinesis).

LO: State what is meant by homologous pairs of chromosomes



- Homologous chromosomes are chromosomes, which exist <u>in pairs</u> (one maternal and one paternal) and each pair has the <u>same shape, size, length, position of centromere and sequence of genes / gene loci.</u>
- <u>One is inherited from the male parent and the other is inherited from the female parent</u>. Hence, they <u>can</u> have <u>different alleles.</u>

LO: Identify, with the aid of diagrams, the main stages of meiosis (names of the sub-divisions of prophase are not required)



Stages of meiosis

Meiosis I:

Prophase I - Chromatin threads condense, coil and shorten to form chromosomes, spindle fibre forms and nucleolus and nuclear membrane disappears
Homologous chromosomes pair up (synapsis). Crossing over may occur between homologous chromosomes, resulting in new combinations of alleles. Point at which they cross over is called the chiasma.
Metaphase I- Homologous chromosomes line up in pairs along the equator of the cell attached to the spindle fibre at the centromere.

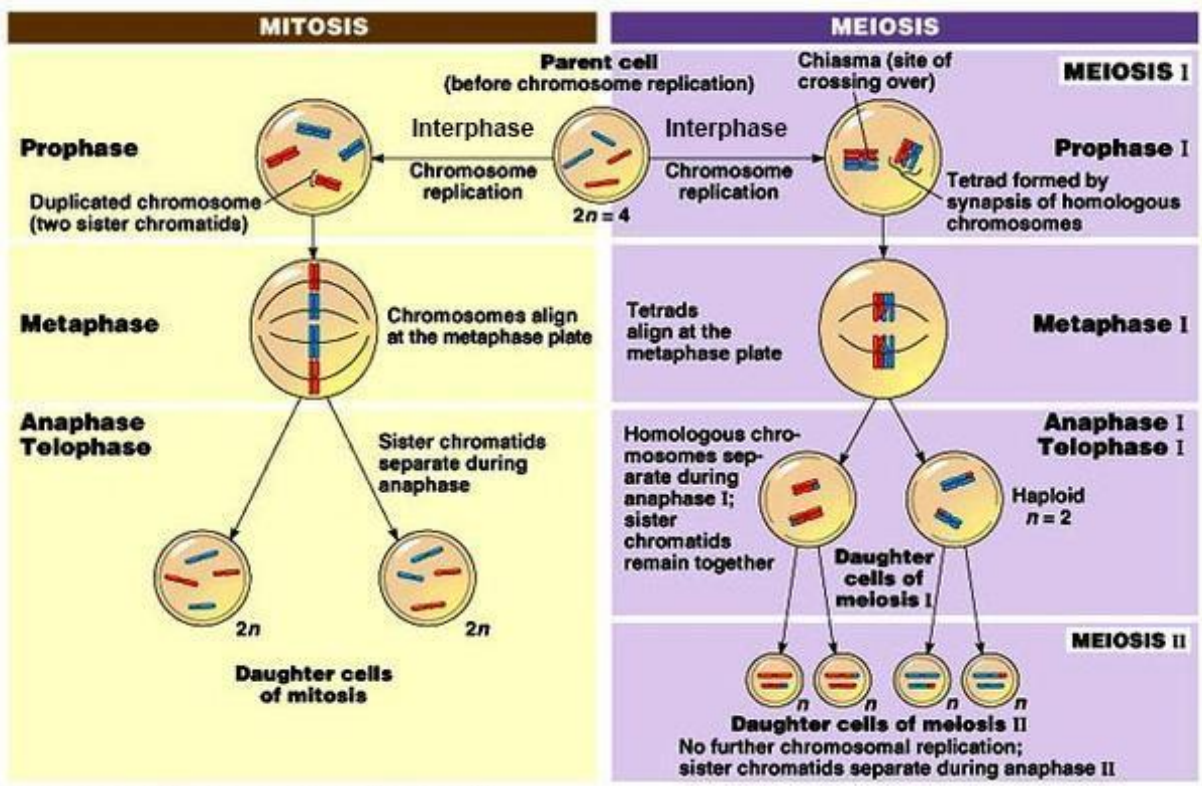
Independent assortment occurs where pairs of homologous chromosomes line up randomly along the equator, resulting in new combinations of chromosomes.
Anaphase I – Homologous chromosomes separate and each chromosome is pulled to opposite poles of the cell
Telophase I - Nuclear envelop and nucleolus reforms, spindle fibre disintegrate, chromosomes uncoil back to chromatin threads and cleavage furrow forms, followed by the division of cytoplasm (cytokinesis I).

Meiosis II:

Prophase II - Chromatin threads condense, coil and shorten to form chromosomes, spindle fibre forms and nucleolus and nuclear membrane disappears
Metaphase II - Chromosomes line up singly along the equator of the cell attached to the spindle fibre at the centromere
Anaphase II - Centromeres split and sister chromatids separate to form daughter chromosomes which are pulled to opposite poles of the cell
Telophase II - Nuclear envelop and nucleolus reforms, spindle fibre disintegrate, chromosomes uncoil back to chromatin threads and cleavage furrow forms, followed by the division of cytoplasm (cytokinesis II), producing 4 haploid daughter cells.

Stage	**Number of chromosomes**	**Amount of DNA**
Start of interphase	2n (diploid)	2n
End of interphase	2n (diploid)	4n (doubled due to DNA replication)
End of meiosis I	n (haploid)	2n
End of meiosis II	n (haploid)	n

Differences between mitosis and meiosis



Mitosis	Meiosis
Occurs in some cells such as adult stem cells	Occurs in only reproductive organs
Function: **growth** of organism and **repair** of tissue	Function: produces **gametes** for sexual reproduction
Involves **one** nuclear division to produce **two diploid** daughter cells	Involves **two** nuclear divisions to produce **four haploid** daughter cells
Daughter cells have the **same** number of chromosomes as parent cell	Daughter cells have **half** the number of chromosomes as parent cell
Daughter cells are **genetically identical** to parent cell and each other	**Genetic variation** occurs in the daughter cells
Homologous chromosomes do not pair up	Homologous chromosomes pair up at prophase I
No crossing over	Crossing over may occur

LO: Define the terms haploid and diploid, and explain the need for a reduction division process prior to fertilisation in sexual reproduction

- Haploid is a condition of cells that contain half the number of chromosomes, n of the parent cell.
- Diploid is a condition of cells that contain the full number of chromosomes, 2n as in the normal body cell.
- Reduction division is a type of cell division that produces cells with haploid number of chromosomes.

Need for a reduction division process prior to fertilization:

- Fertilisation is the fusion of the nucleus of the haploid male gamete with the nucleus of the haploid female gamete, to form a diploid zygote, restoring the diploid number of chromosomes in the species.

LO: State how meiosis and fertilisation can lead to variation

- Genetic variations due to meiosis:
  - Crossing over during Prophase I leads to new combinations of alleles.
  - Independent assortment of chromosomes during Metaphase I results in new combination of chromosomes.

- Fertilisation of male gamete and female gamete is also a random process, which can result in genetic variation in the offspring as the gametes produced by meiosis are genetically different.