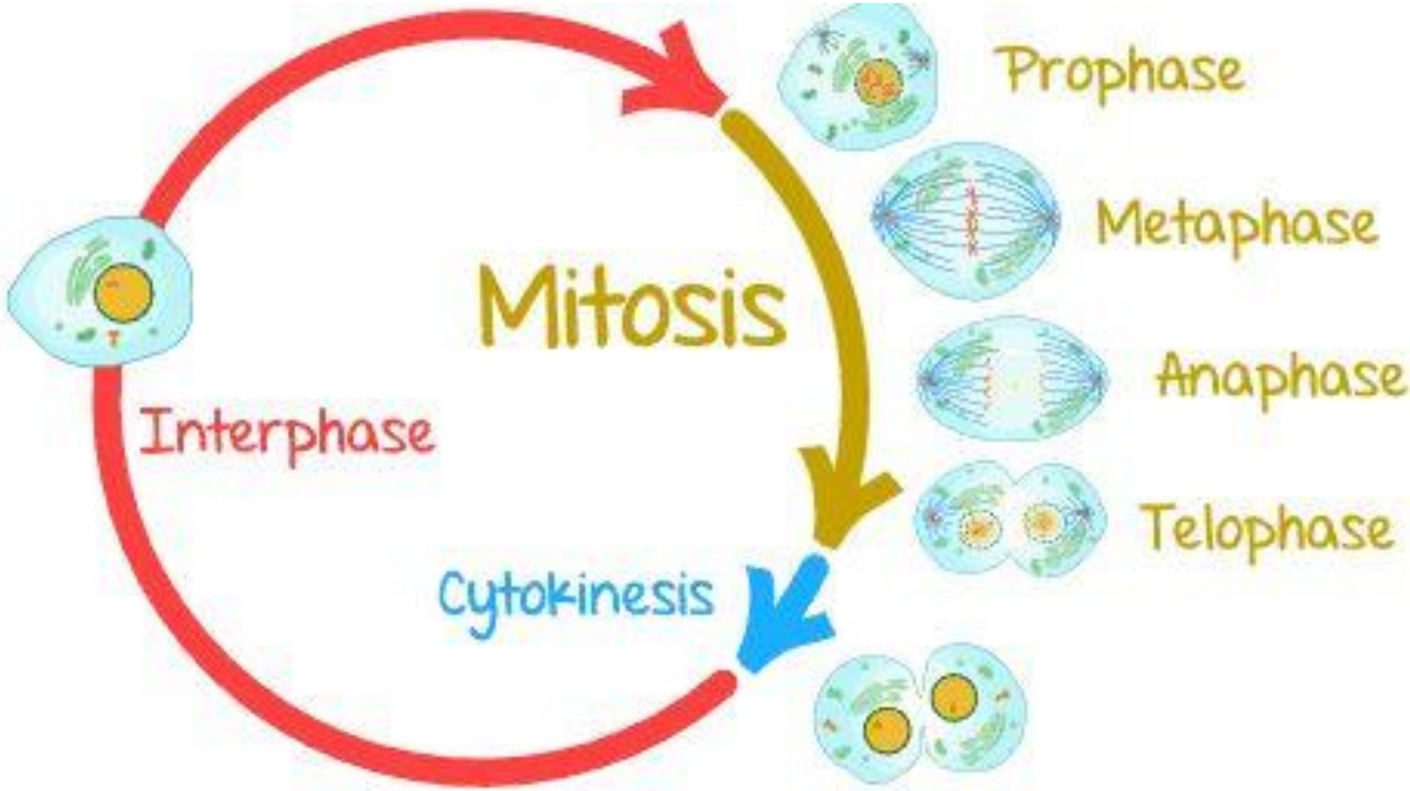
Cell cycle

- The cell cycle or cell-division cycle is the series of events that take place in a cell leading to its division and duplication of its DNA to produce two daughter cells.
- In eukaryotes the cell cycle is divided into three periods: interphase, the mitotic (M) phase, and cytokinesis.
- During interphase, the cell grows, accumulating nutrients needed for mitosis, preparing it for cell division and duplicating its DNA. During the mitotic phase, the chromosomes separate. During the final stage, cytokinesis, the chromosomes and cytoplasm separate into two new daughter cells.


Prophase
Metaphase
Mitosis
Anaphase
Interphase
Telophase
Cytokinesis

Interphase

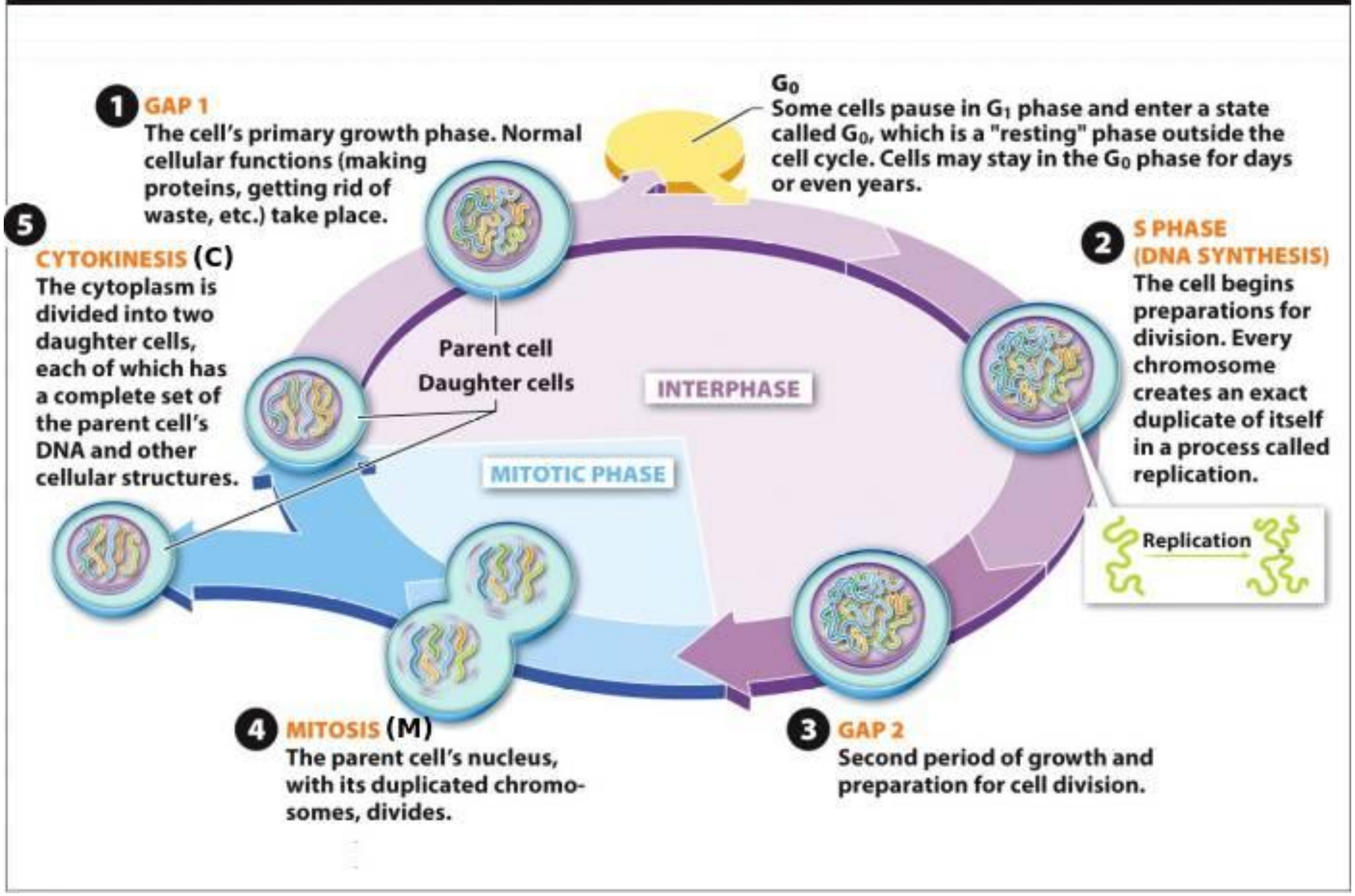
- Interphase itself consists of 3 phases:

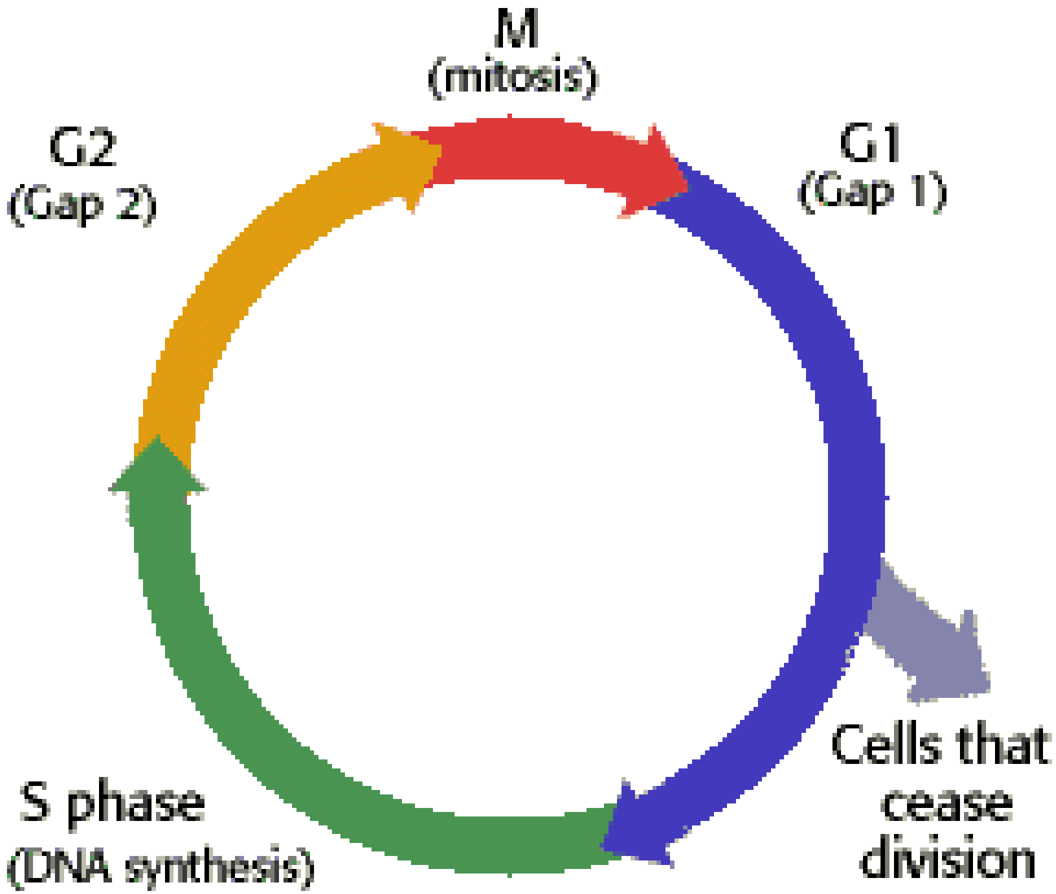
1. G1 (Gap 1) phase - Cells increase in size in Gap 1. Cell is getting ready for DNA synthesis.
2. S (Synthesis) phase - DNA replication occurs during this phase.
3. G2 (Gap 2) phase - During the gap between DNA synthesis and mitosis, the cell will continue to grow

G0 phase

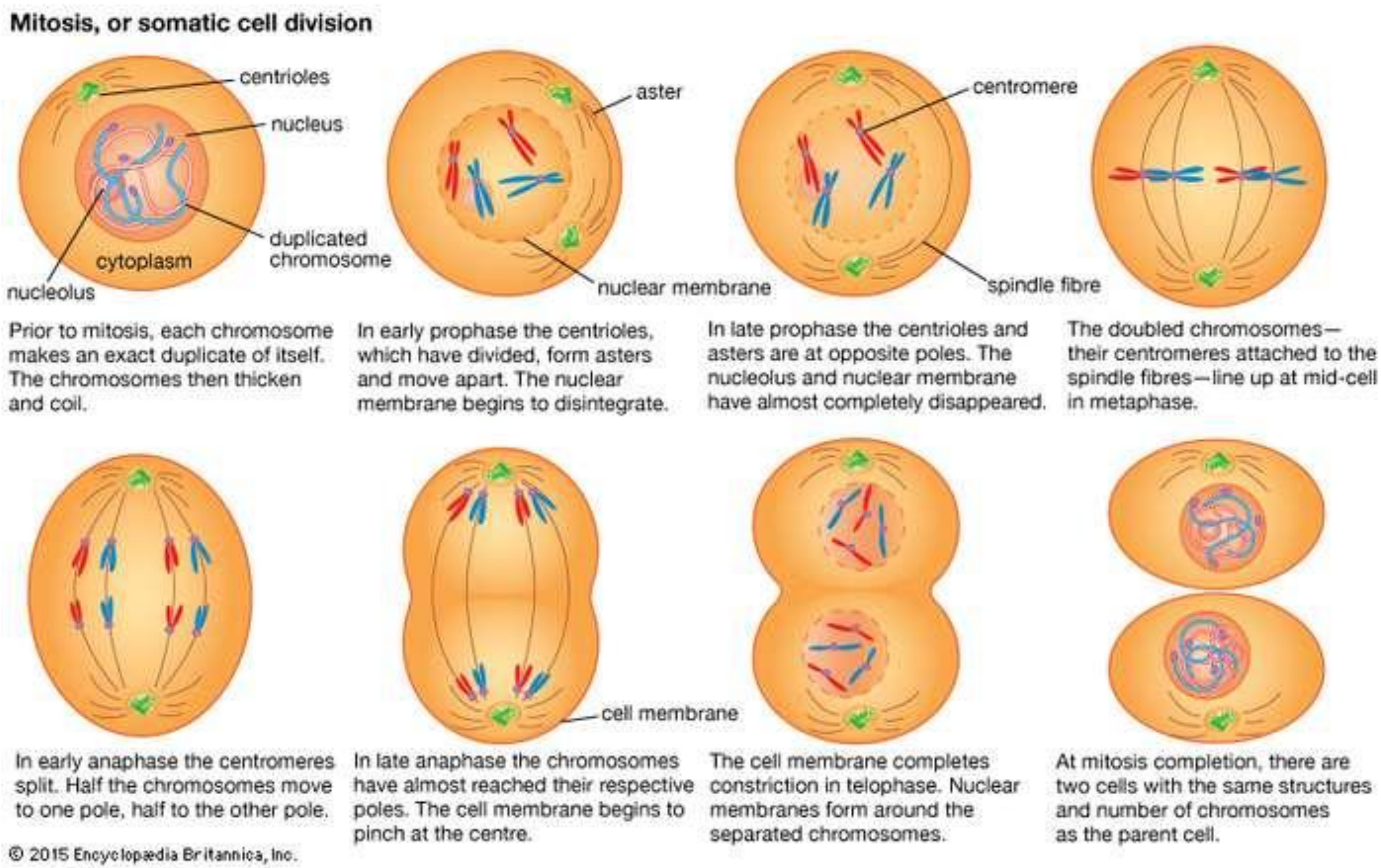
- Sometimes cell can enter G0 phase (quiescence)
- G0 is a resting phase where the cell has left the cycle and has stopped dividing.
- Non-proliferative (non-dividing) cells in multicellular eukaryotes generally enter the quiescent G0 state from G1 and may remain quiescent for long periods of time, possibly indefinitely (as is often the case for neurons).

EUKARYOTIC CELL CYCLE




M
(mitosis)
G1
(Gap 1)
G2
(Gap 2)
S phase
(DNA synthesis)
Cells that cease division

Mitosis


Mitosis, or somatic cell division
centrioles
nucleus
duplicated chromosome
cytoplasm
nucleolus
aster
nuclear membrane
centromere
spindle fibre
Prior to mitosis, each chromosome makes an exact duplicate of itself. The chromosomes then thicken and coil.
In early prophase the centrioles, which have divided, form asters and move apart. The nuclear membrane begins to disintegrate.
In late prophase the centrioles and asters are at opposite poles. The nucleolus and nuclear membrane have almost completely disappeared.
The doubled chromosomes—their centromeres attached to the spindle fibres—line up at mid-cell in metaphase.
cell membrane
In early anaphase the centromeres split. Half the chromosomes move to one pole, half to the other pole.
In late anaphase the chromosomes have almost reached their respective poles. The cell membrane begins to pinch at the centre.
The cell membrane completes constriction in telophase. Nuclear membranes form around the separated chromosomes.
At mitosis completion, there are two cells with the same structures and number of chromosomes as the parent cell.
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Cell cycle Checkpoints

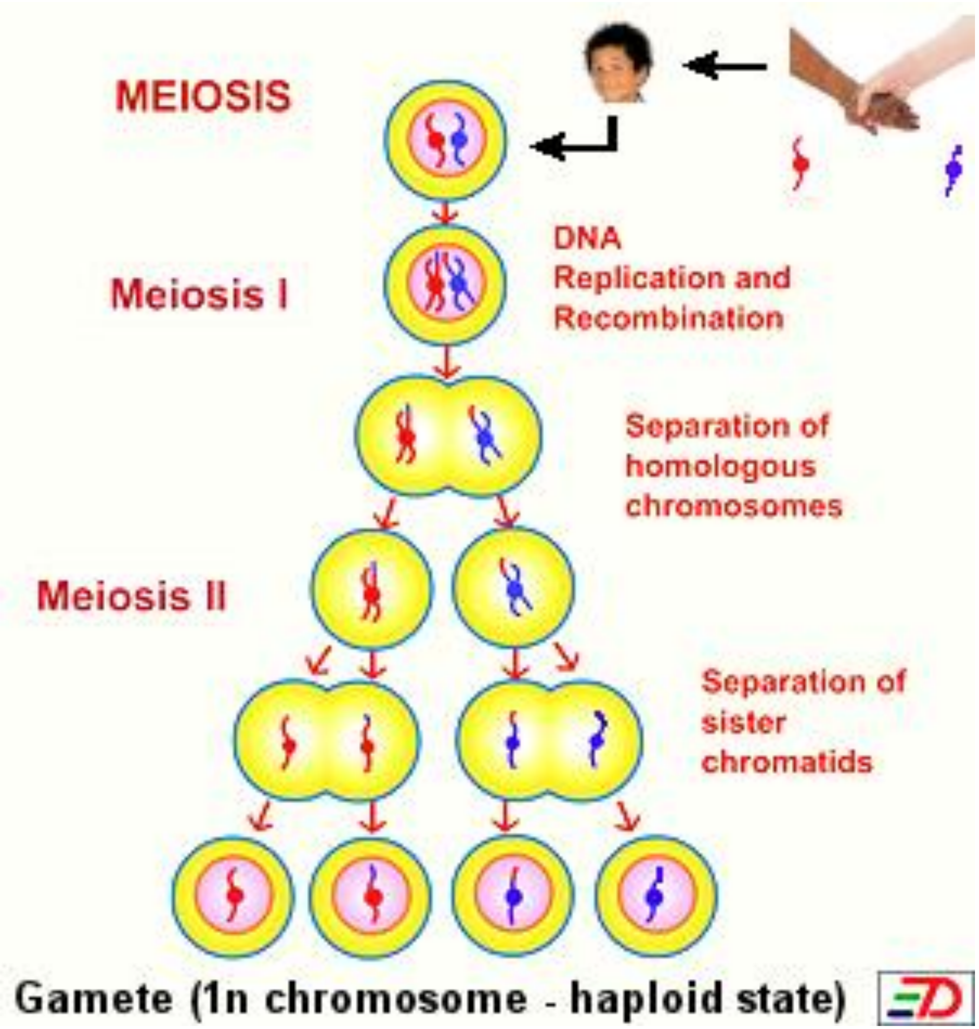
- Cell cycle checkpoints are used by the cell to monitor and regulate the progress of the cell cycle.
- Checkpoints prevent cell cycle progression at specific points, allowing verification of necessary phase processes and repair of DNA damage.
- The cell cannot proceed to the next phase until checkpoint requirements have been met.
- Checkpoints typically consist of a network of regulatory proteins that monitor and dictate the progression of the cell through the different stages of the cell cycle.

Meiosis

- Meiosis is a specialized type of cell division that reduces the chromosome number by half, creating four haploid cells, each genetically distinct from the parent cell that gave rise to them.
- Meiosis usually occur during germ cell formation.
- Meiosis consists of two cell divisions – meiosis I and meiosis II

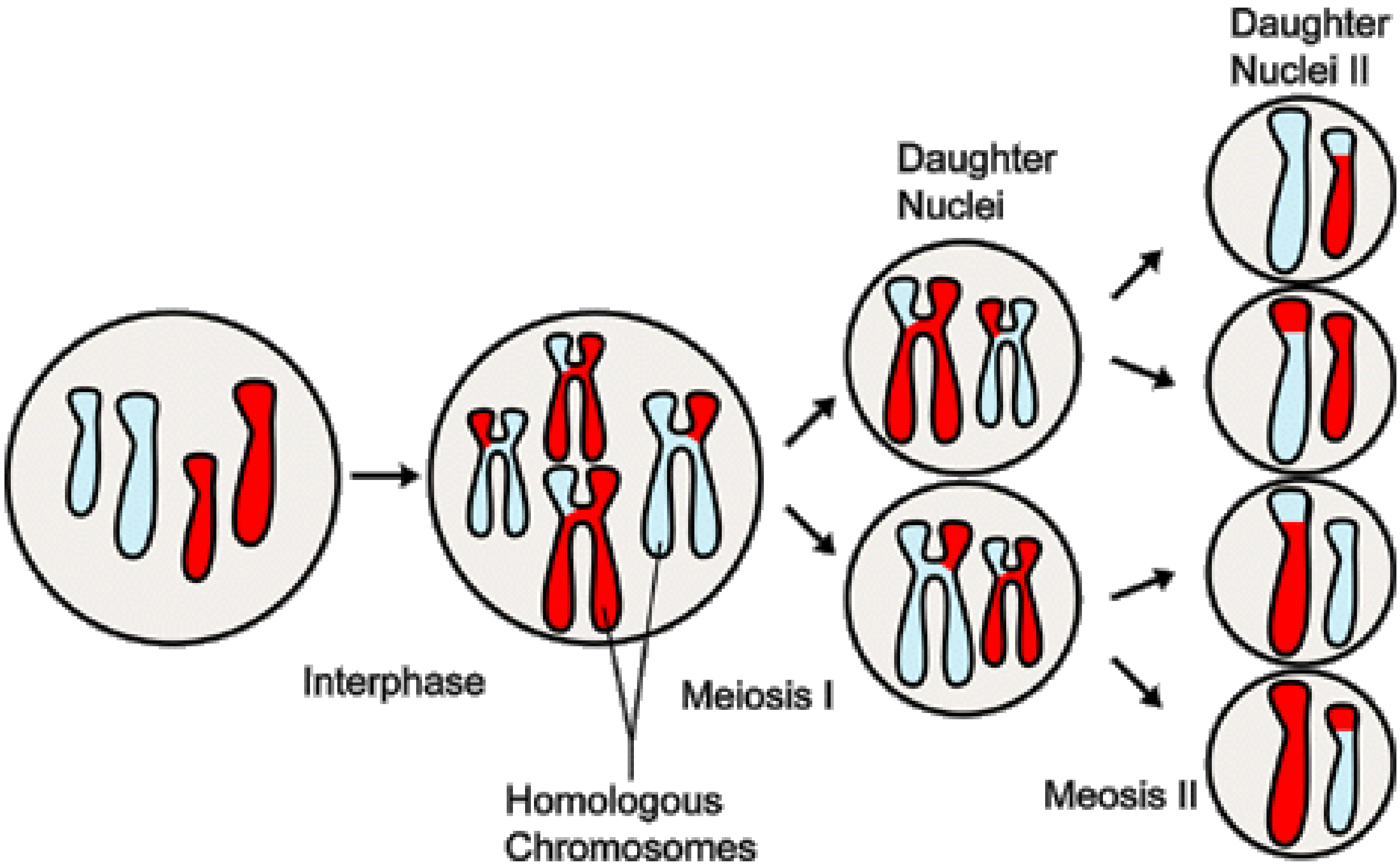
Meiosis I

- Meiosis I segregates homologous chromosomes, which are joined as tetrads (2n, 4c), producing two haploid cells (n chromosomes, 23 in humans) which each contain chromatid pairs (1n, 2c). During meiosis I genetic recombination (crossingover) occurs between homologous chromososmes


MEIOSIS
Meiosis I
DNA
Replication and
Recombination
Separation of
homologous
chromosomes
Meiosis II
Separation of
sister
chromatids
Gamete (1n chromosome - haploid state)

Meiosis II

- Meiosis II is the second meiotic division, and usually involves separation of sister chromatids. Mechanically, the process is similar to mitosis, though its genetic results are fundamentally different.
- Meiosis II starts with two haploid cells (with n chromosomes, each consisting of two sister chromatids) produced in meiosis I
- The end result is production of four haploid cells (n chromosomes, 23 in humans).


Daughter
Nuclei II
Daughter
Nuclei
Interphase
Meiosis I
Homologous
Chromosomes
Meosis II