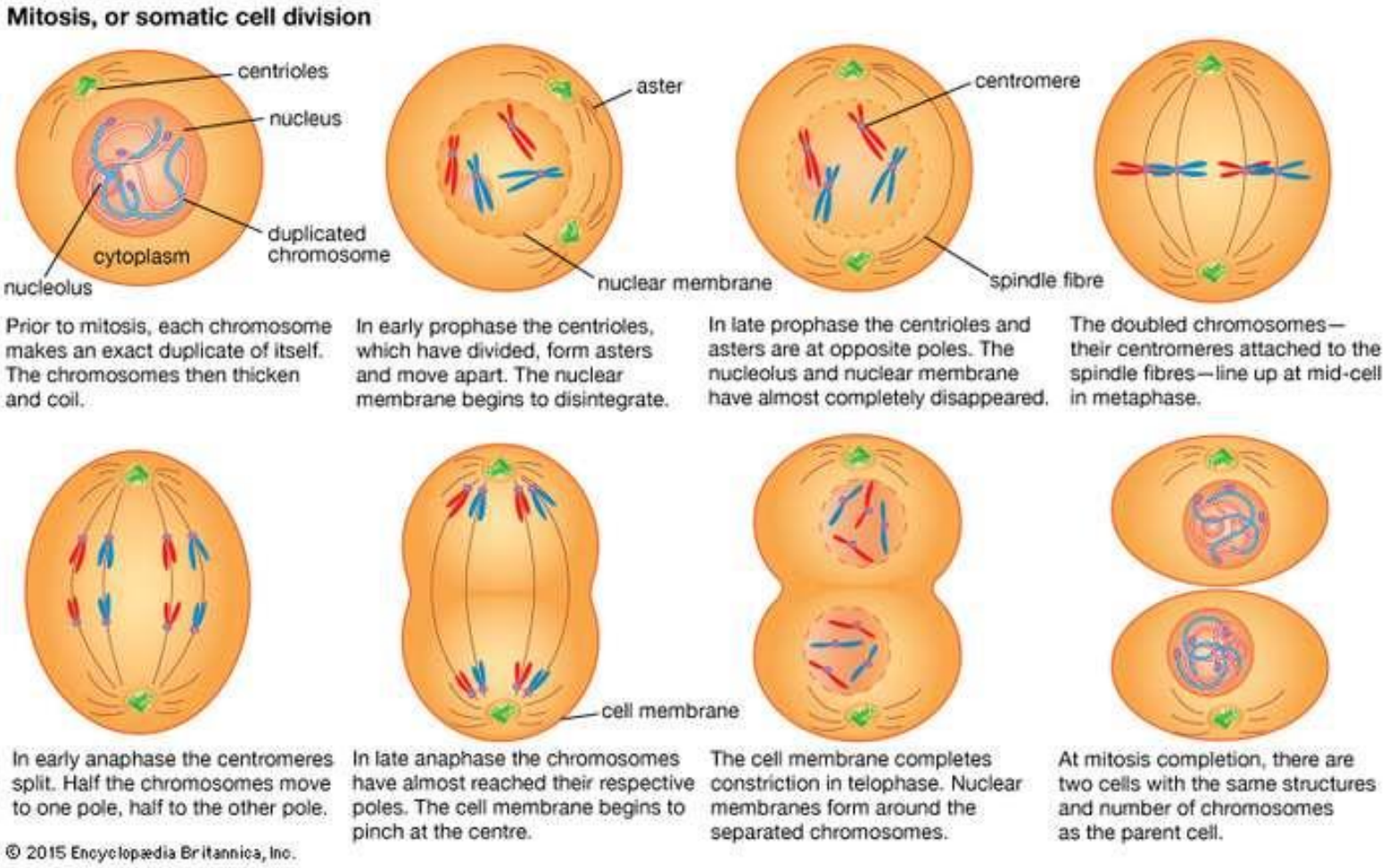
Meiosis and chromosome assortment

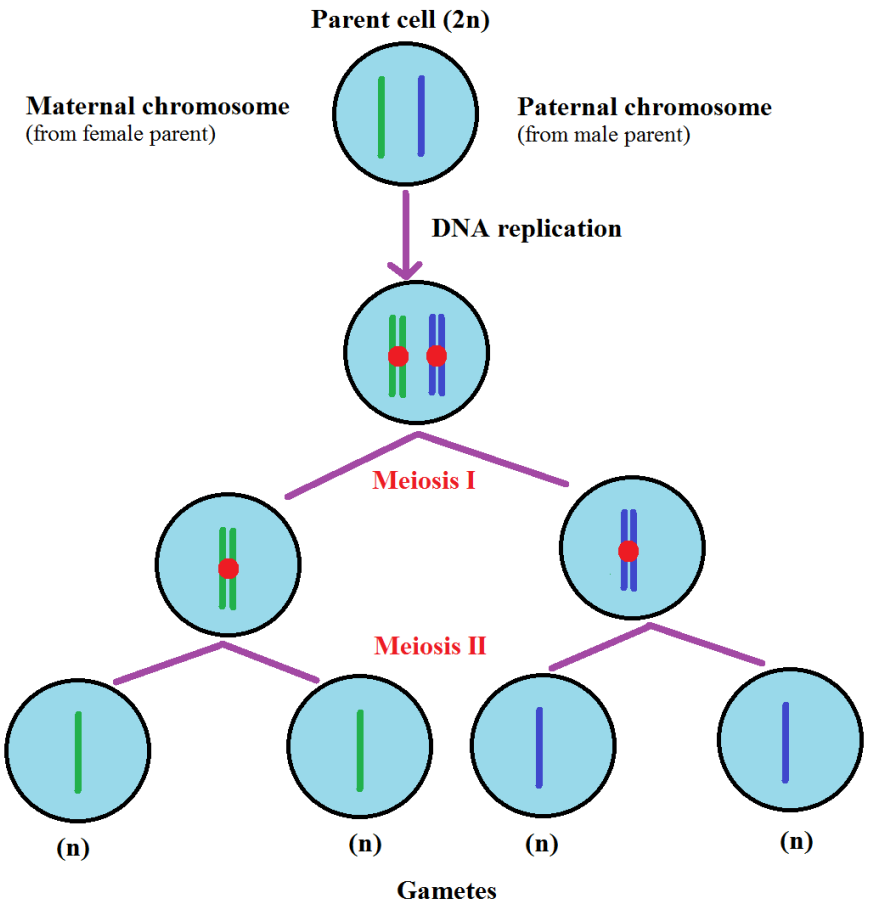
Mitosis – somatic cell division



Meiosis

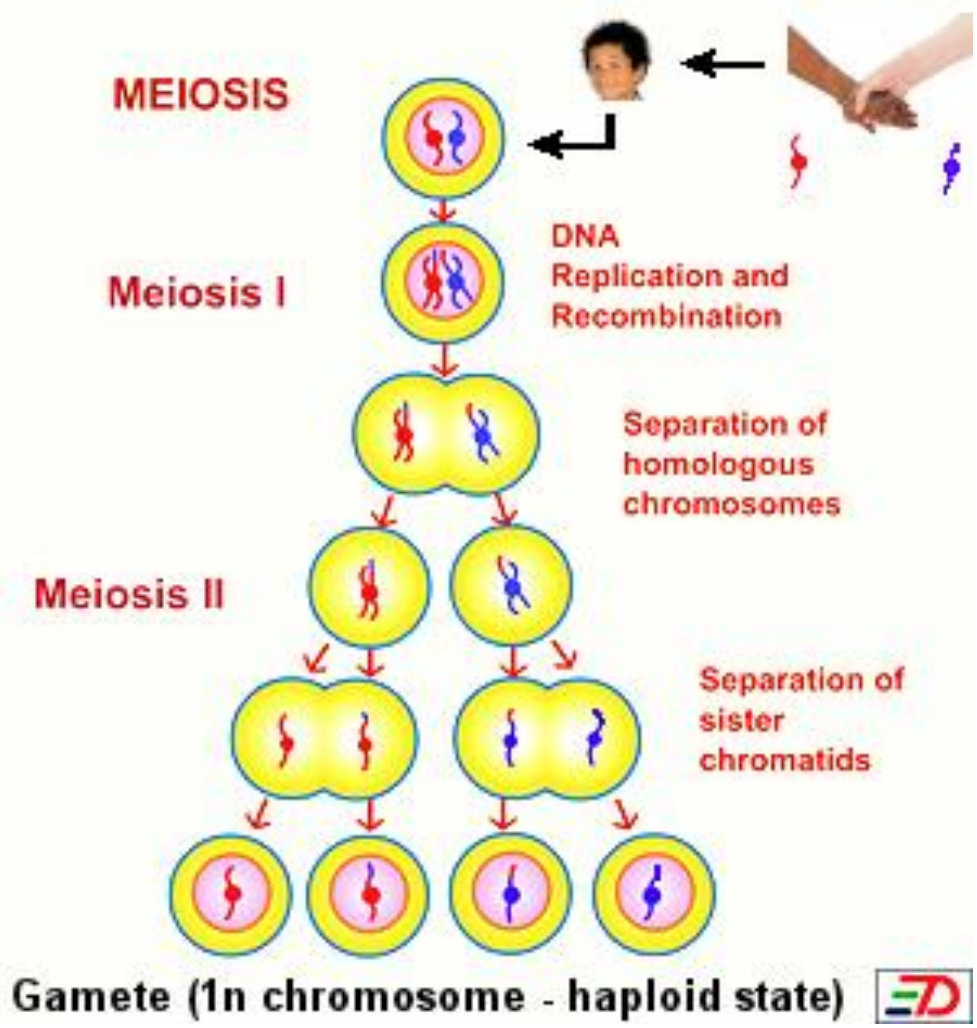
- *Meiosis* is a specialized type of cell division that reduces the chromosome number by half, creating four haploid cells, each genetically distinct from the parent cell that gave rise to them.
- Meiosis usually occur during germ cell formation.
- Meiosis consists of two cell divisions – *meiosis I*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

Meiosis


Parent cell (2n)
Maternal chromosome
(from female parent)
Paternal chromosome
(from male parent)
DNA replication
Meiosis I
Meiosis II
(n)
(n)
(n)
(n)
Gametes

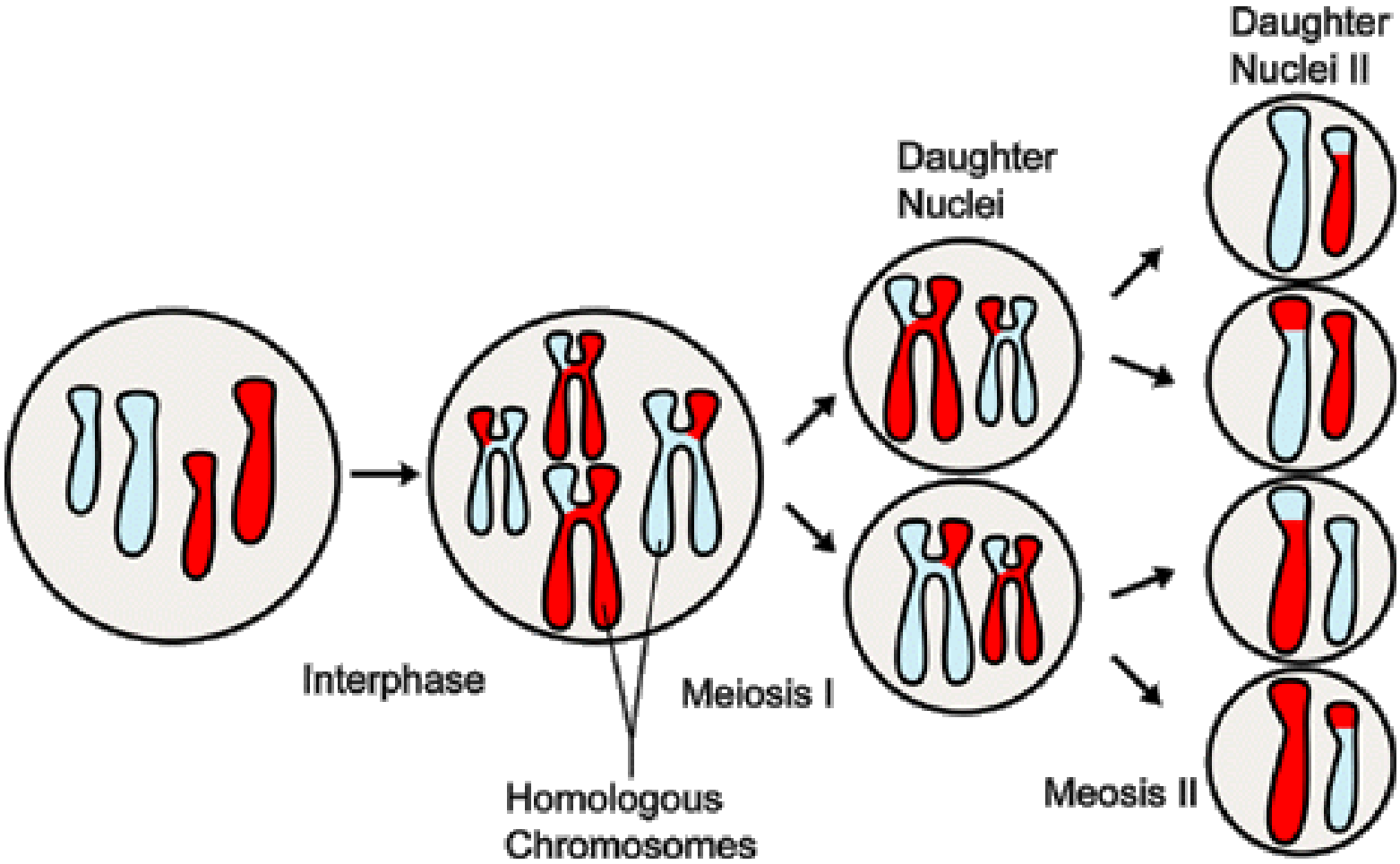
Meiosis I

- 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 chromosomes

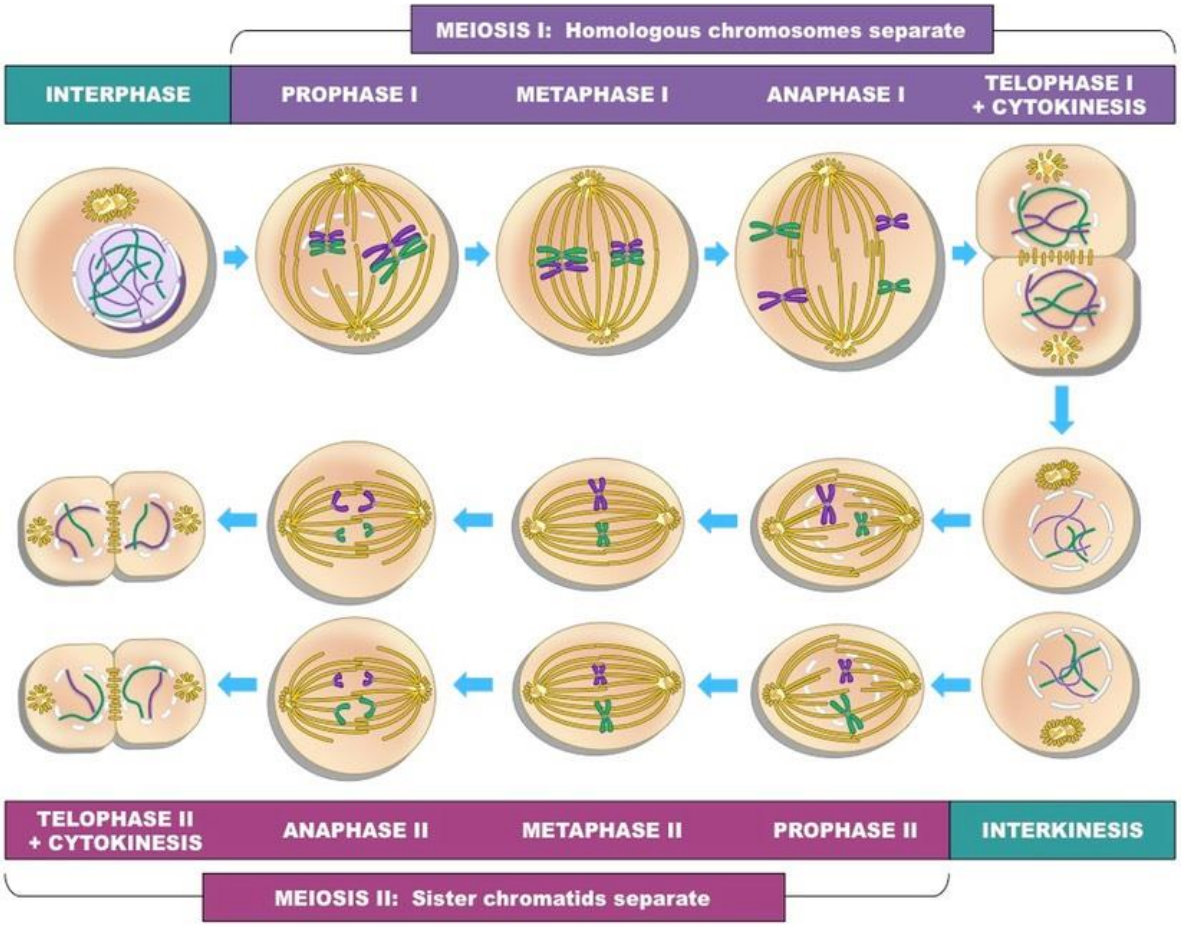

MEIOSIS
Meiosis I
DNA
Replication and
Recombination
Separation of
homologous
chromosomes
Meiosis II
Separation of
sister
chromatids
Gamete (1n chromosome - haploid state)

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).

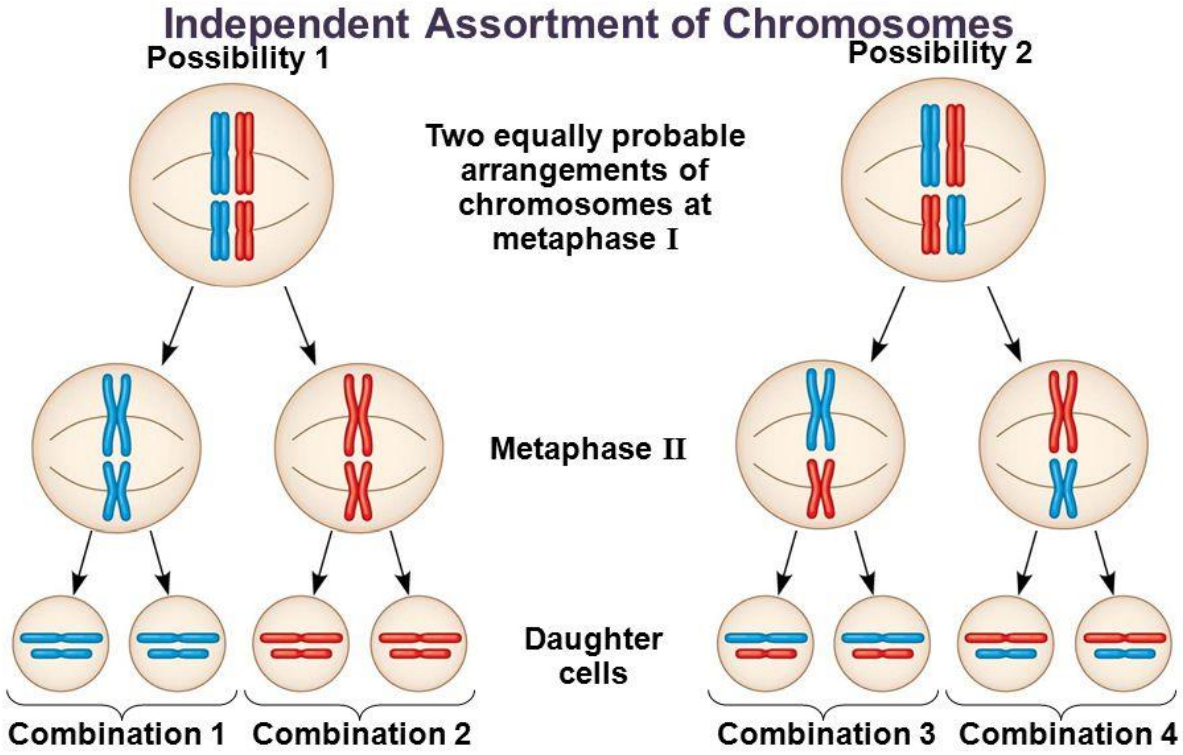

Daughter
Nuclei II
Daughter
Nuclei
Interphase
Meiosis I
Homologous
Chromosomes
Meosis II

Meiosis


MEIOSIS I: Homologous chromosomes separate
INTERPHASE
PROPHASE I
METAPHASE I
ANAPHASE I
TELOPHASE I + CYTOKINESIS
TELOPHASE II + CYTOKINESIS
ANAPHASE II
METAPHASE II
PROPHASE II
INTERKINESIS
MEIOSIS II: Sister chromatids separate

- **Genetic recombination** is the exchange of genetic material between different organisms which leads to production of offspring with combinations of traits that differ from those found in either parent.
- Genetic recombination occurs in both prokaryotes and eukaryotes
- Genetic recombination creates diversity of genomes within the same species. This creates greater adaptability of the species to changing ecological conditions in the process of evolution.
- In sexually reproducing eukaryotes genetic recombination occurs by re-assortment of chromosomes, gene conversion and chromosomal crossover.

Chromosome assortment



The number of combinations possible when chromosomes assort independently into gametes is 2^n, where *n* is the haploid number.

Humans have 23 pairs of chromosomes. Therefore the total number of combinations of parental chromosomes in a child is 2^{64} or approximately 70 trillion.