

Meiosis



Chromosome Number

Genes are located on chromosomes.

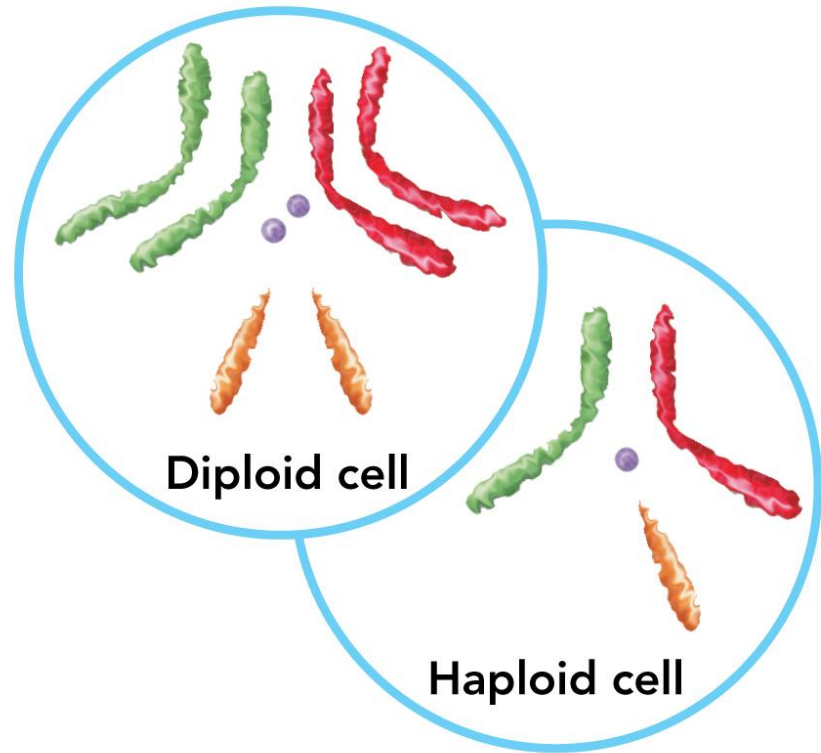
Homologous: chromosomes with the same genes, one originally from each of the organism's parents

Diploid: containing both sets of homologous chromosomes; $2N$

- Means “double”

Haploid: containing only a single set of chromosomes; $1N$

- Means “single”
- Gametes of sexually reproducing organisms



Reviewing Mitosis



Prophase

Metaphase

Anaphase

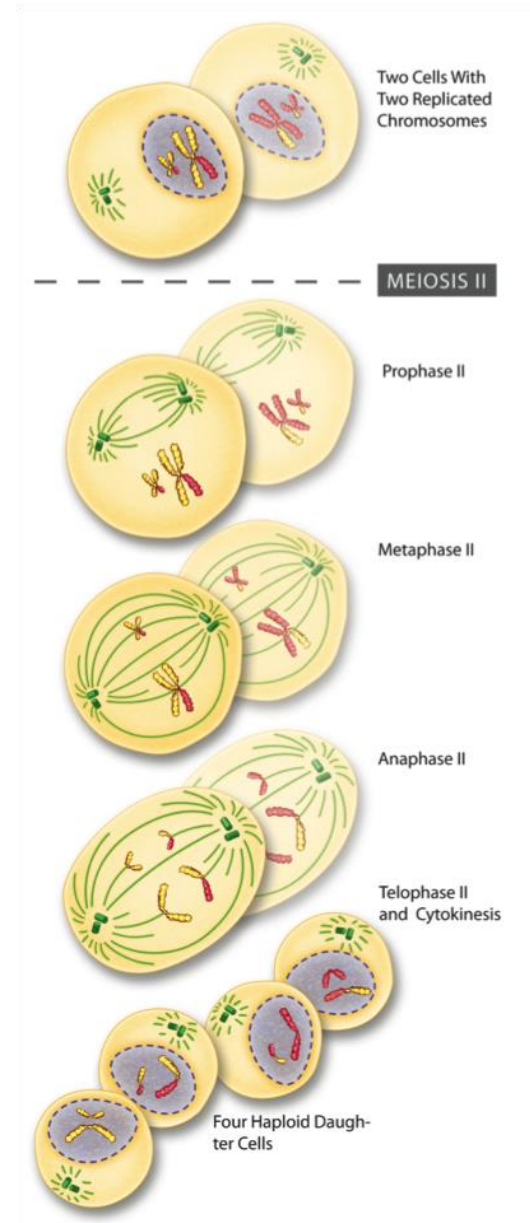
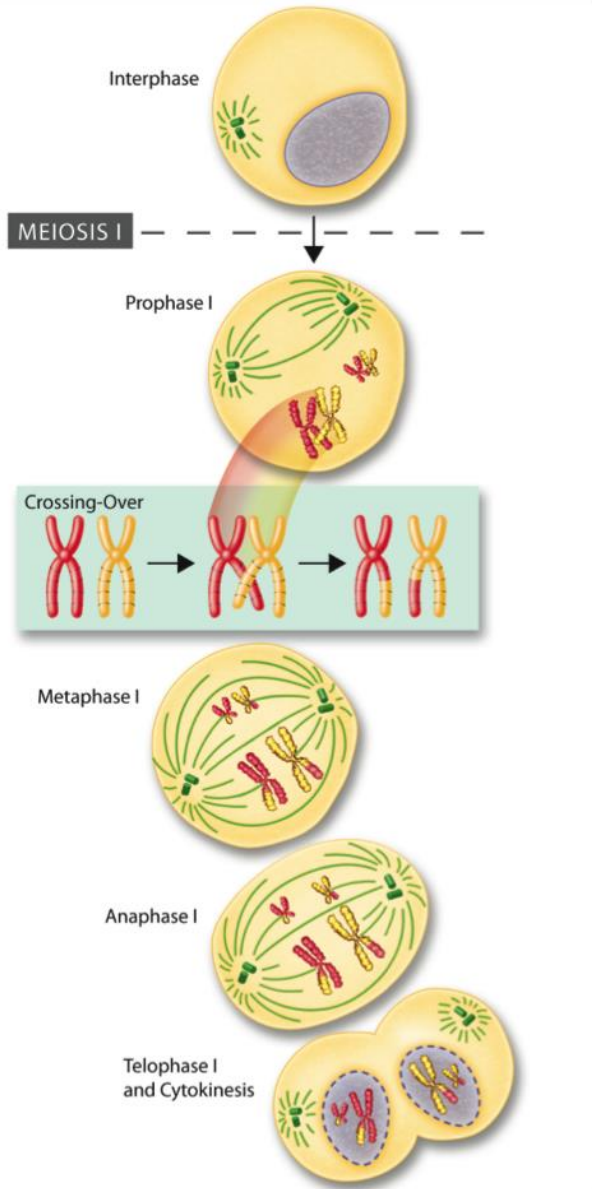
Telophase

Meiosis

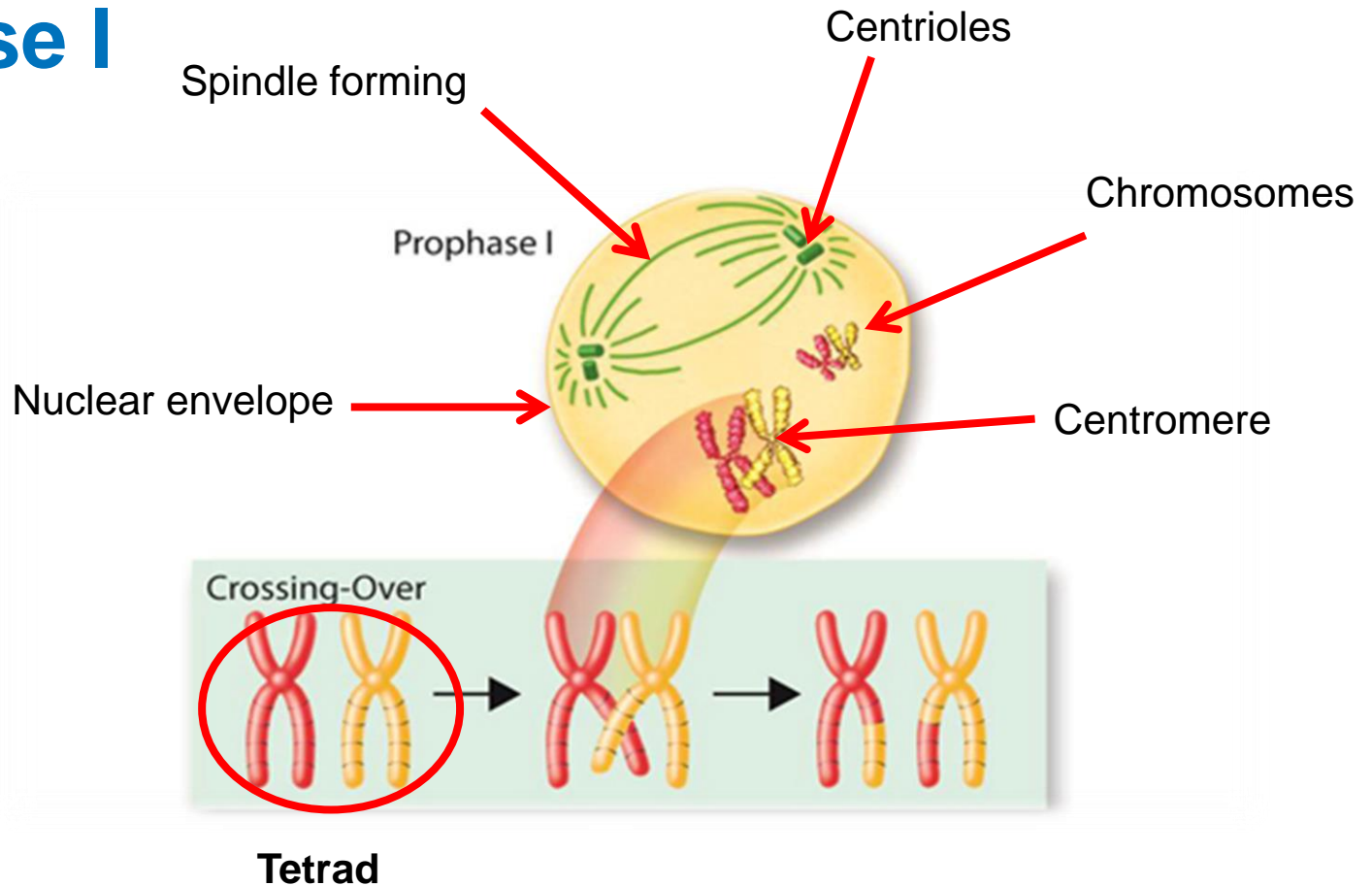
Meiosis: process in which the number of chromosomes per cell is cut in half through the separation of homologous chromosomes in a diploid cell

- Similar to mitosis as it has similar steps
- Different from mitosis as it has two distinct divisions called meiosis I and meiosis II
- A single diploid cell has produced 4 haploid cells
- Steps
 - Interphase
 - Meiosis I
 - Cytokinesis I
 - Meiosis II
 - Cytokinesis II

Meiosis



Prophase I

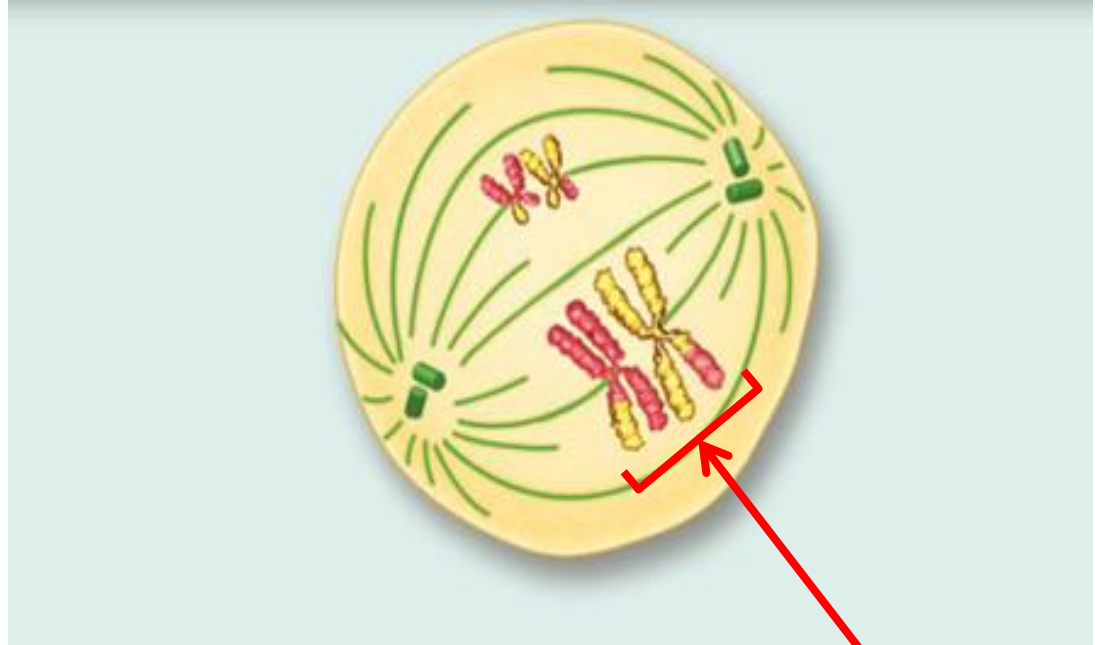


In prophase I of meiosis, each replicated chromosome pairs with its corresponding homologous chromosome. This pairing forms a structure called a **tetrad** which contains 4 chromatids.

Crossing over: bits and pieces of the homologous chromosomes are exchanged

Metaphase I

As prophase I ends, a spindle forms and attaches to each tetrad.

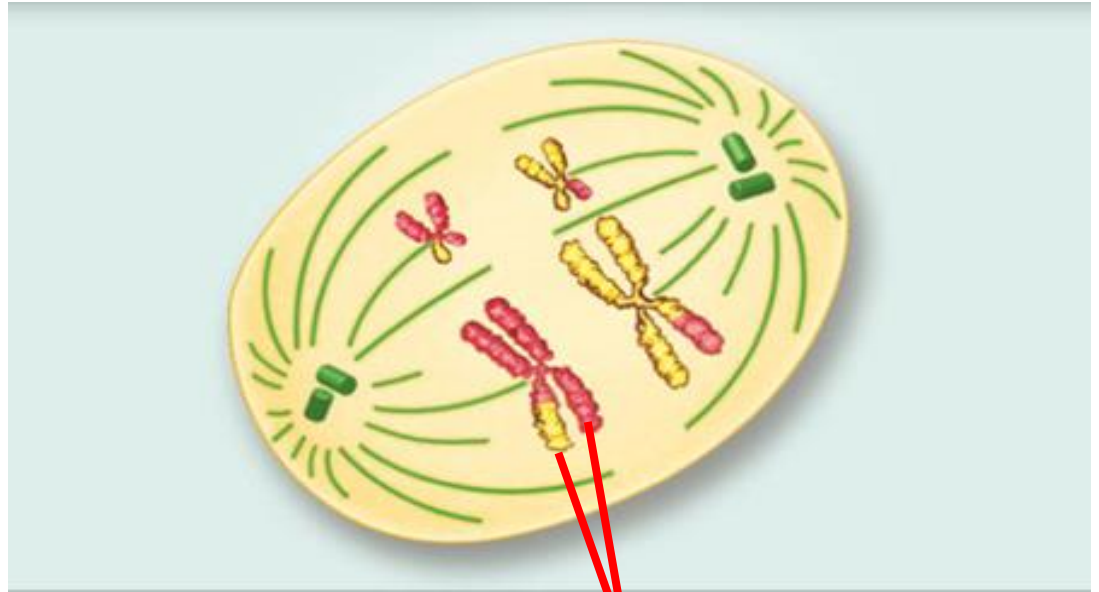


During metaphase I of meiosis, paired homologous chromosomes line up across the center of the cell.

Pair of homologous chromosomes

Anaphase I

As the cell moves into anaphase I, the homologous pairs of chromosomes separate.

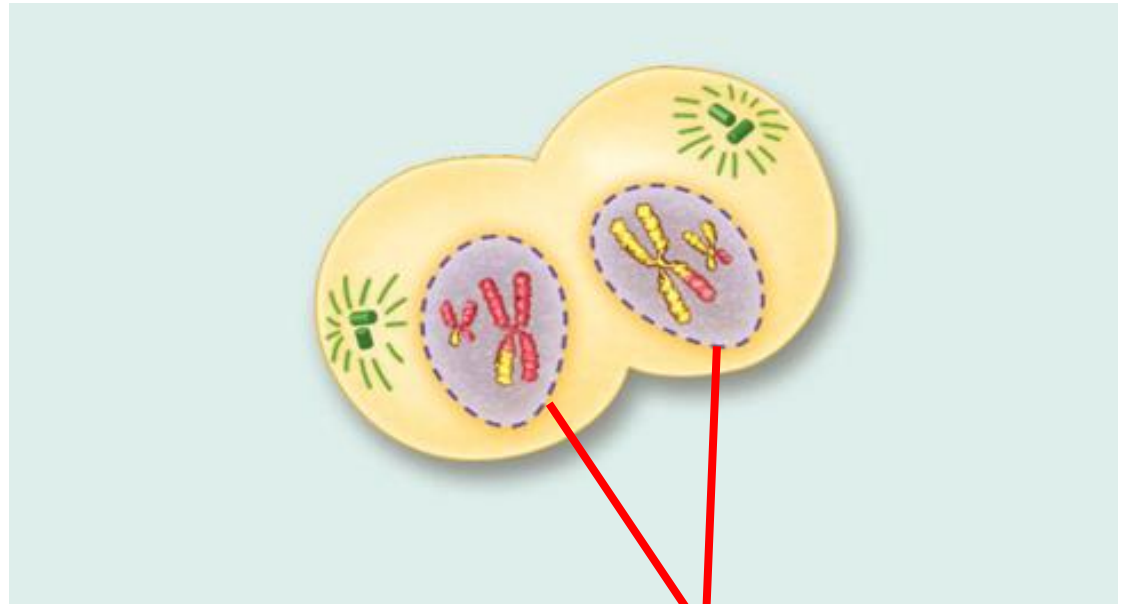


Sister chromatids

During anaphase I, spindle fibers pull each homologous chromosome pair toward opposite ends of the cell.

Telophase I and Cytokinesis

When anaphase I is complete, the separated chromosomes cluster at opposite ends of the cell.



Nuclear envelopes reforming

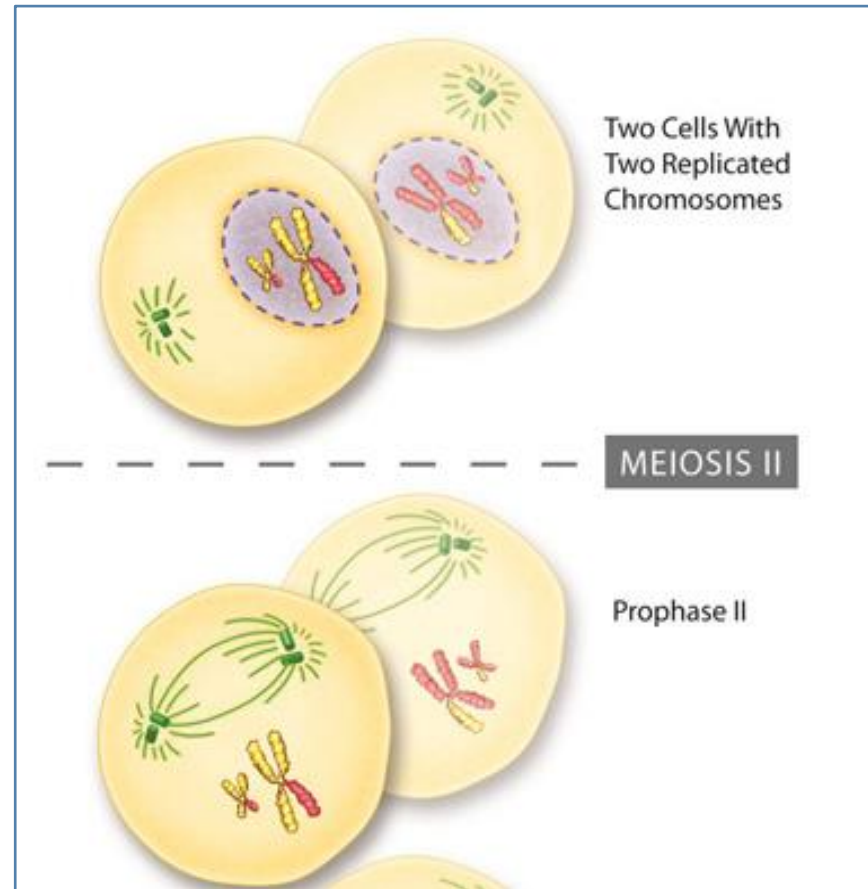
The next phase is telophase I, in which a nuclear membrane forms around each cluster of chromosomes.

Cytokinesis follows, forming 2 new cells.

Prophase II

The 2 cells now enter meiosis II. Unlike the first division, neither cell goes through a round of chromosome replication before entering meiosis II.

As the cells enter prophase II, their chromosomes – each consisting of 2 chromatids – become visible.



Metaphase II and Anaphase II

During metaphase II, the chromosomes line up in the center of each cell.

During anaphase II, the paired chromatids separate.

The final 4 phases of meiosis II are similar to those in meiosis I. However, the result is 4 haploid daughter cells.

Metaphase II



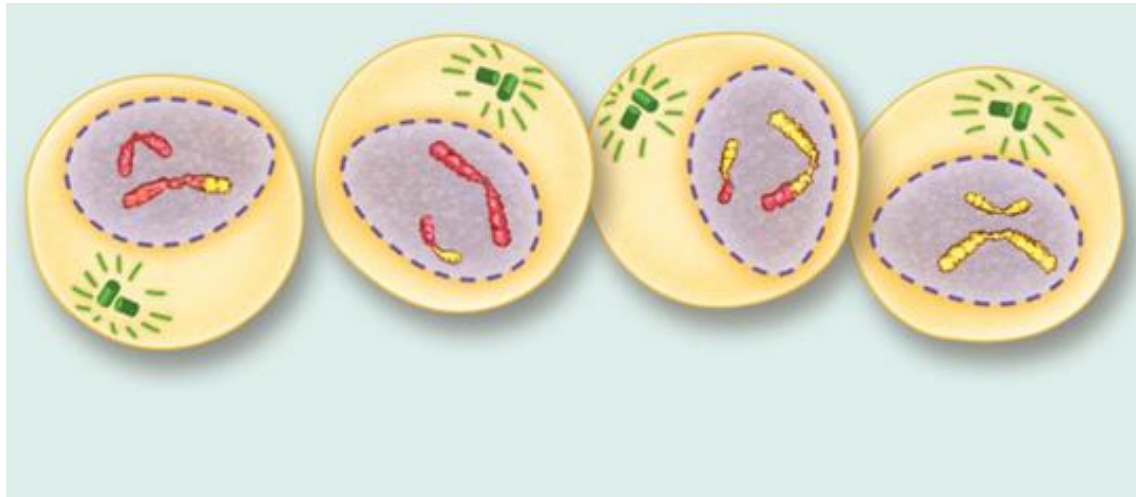
Anaphase II



Telophase II and Cytokinesis

The end product of meiosis is four daughter cells that have half the normal chromosome number.

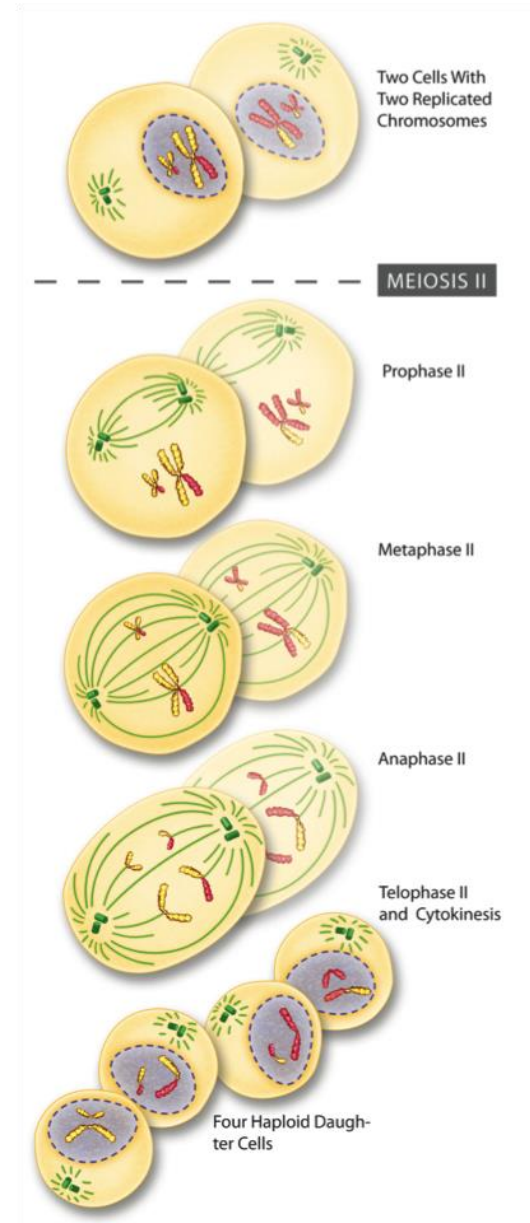
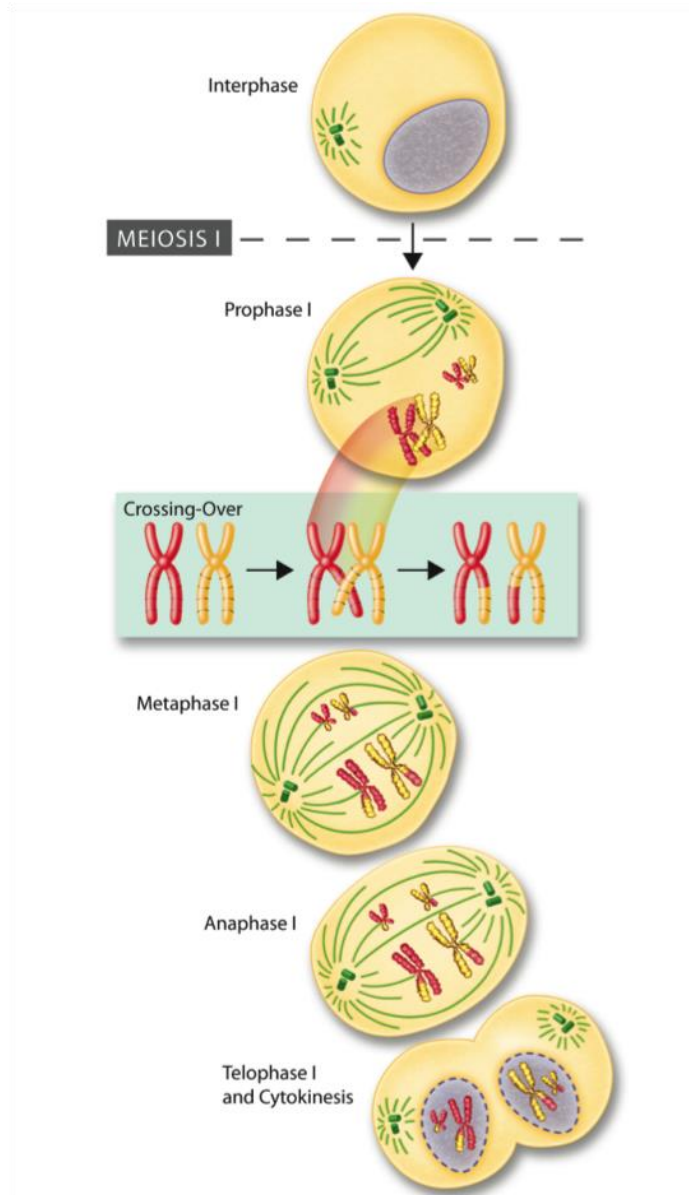
The four daughter cells now contain the haploid number (N) – just 2 chromosomes each.



The haploid cells produced by meiosis develop into the gametes for sexual reproduction.

- In males, these gametes are called sperm
- In females, these gametes are called eggs

Summary of Meiosis

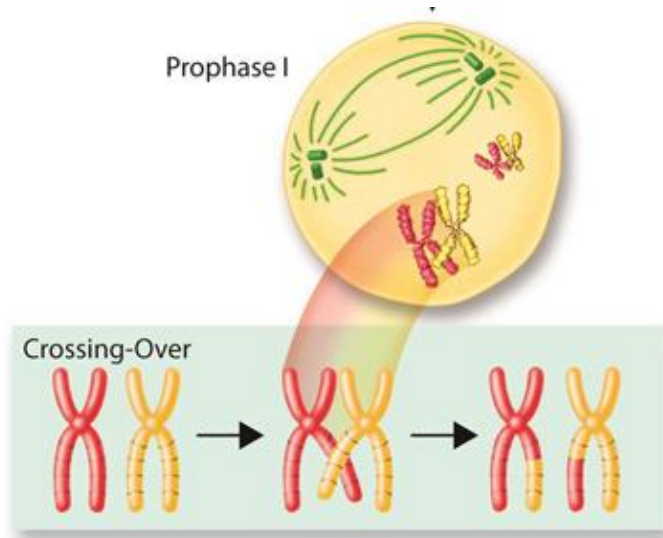


Comparing Mitosis and Meiosis

Mitosis	Meiosis
Asexual reproduction	Early steps in sexual reproduction
Each daughter cell receives a complete diploid set of chromosomes	Each daughter cell receives only a haploid set of chromosomes
No genetic variation	Genetic variation
Does not change the chromosome number of the original cell	Reduces the chromosome number by half
Single cell division production 2 identical daughter cells	Two rounds of cell division and produces a total of 4 daughter cells
Results in the production of 2 genetically identical diploid cells	Results in the production of 4 genetically different haploid cells

Gene Linkage

Alleles of different genes tend to be inherited together when those genes are located on the same chromosome.



- In humans, hair color and eye color are linked.
- Blonde hair and blue eyes
 - Brown hair and brown eyes

Linkage refers to **the closeness of genes or other DNA sequences to one another on the same chromosome**. The closer two genes or sequences are to each other on a chromosome, the greater the probability that they will be inherited together.