Lesson Overview

12.4 Meiosis

Chromosomes—strands of DNA and protein—contain the genes.

genes are located in specific positions on chromosomes.

Humans receive a set (23) of chromosomes from each parent.

23 chromosomes from mom
+ 23 chromosomes from dad
46 total chromosomes or 23 ***pairs***

these chromosomes are **homologous**

A cell containing both sets of chromosomes is ***Diploid*** and is represented by the symbol ***2N***. Most body cells are diploid.

A cell containing only one set of chromosomes is ***Haploid*** and is represented by the symbol ***N***. Gametes (sperm & egg) are haploid.

Meiosis

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

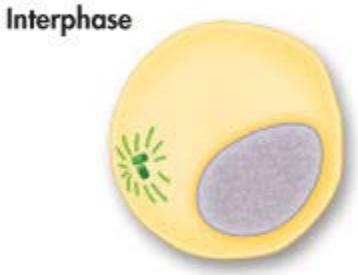
- two distinct divisions, called meiosis I and meiosis II.

- one diploid cell becomes four haploid cells.

Meiosis I

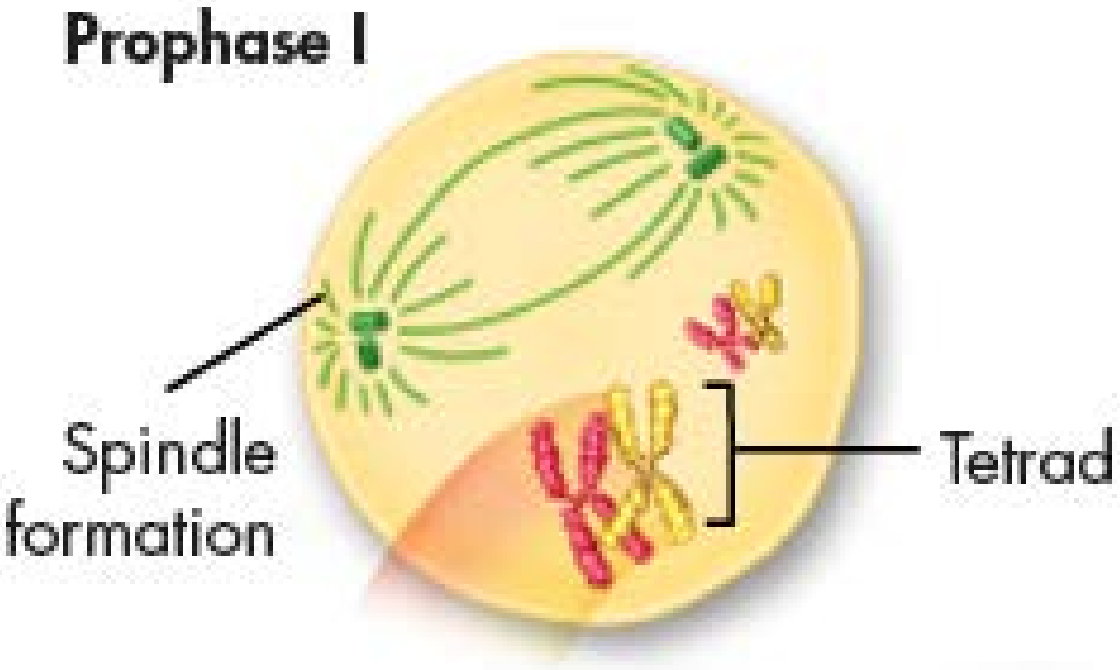
Just prior to meiosis I, the cell undergoes a round of chromosome replication called **interphase I**.

Each replicated chromosome consists of two identical or “sister” **chromatids** joined at the center.



Prophase I

Homologous chromosomes pair, forming a structure called a **tetrad**, which contains four chromatids.



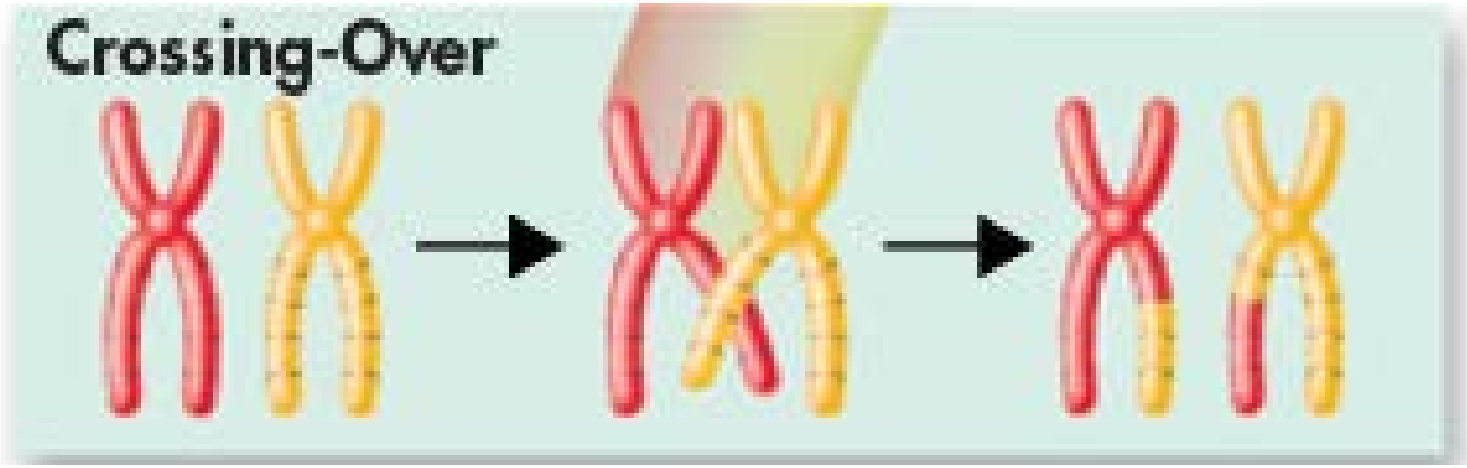
Prophase I

As tetrads form, **crossing-over** occur.

chromatids of homologous chromosomes cross over one another.

crossed sections of the chromatids are exchanged.

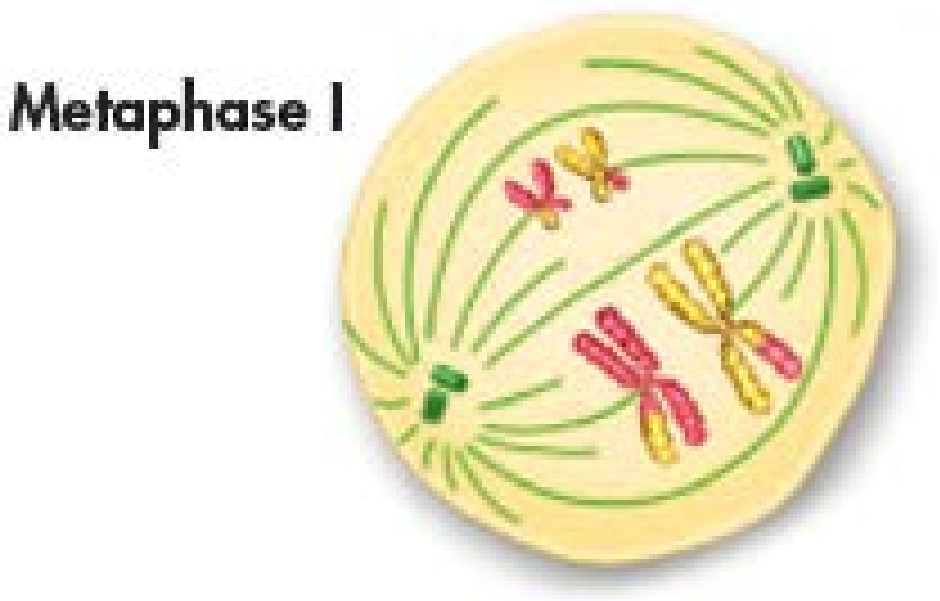
Crossing-over produces new combinations of alleles.



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. Because each homologue could line up on the left or the right side, this phase provides another opportunity for a new combination of traits.



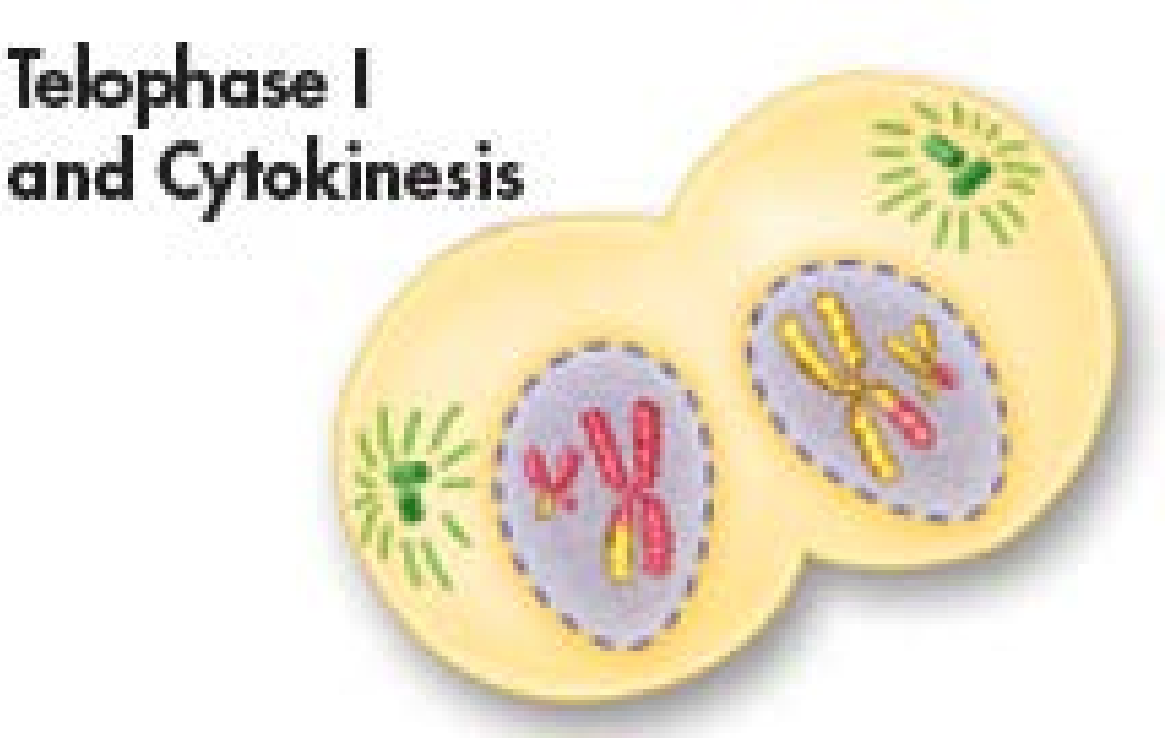
Anaphase I

- spindle fibers pull each homologous chromosome pair apart until the separated chromosomes are clustered at opposite ends of the cell.

Telophase I and Cytokinesis

During telophase I, a nuclear membrane forms around each cluster of chromosomes.

Cytokinesis follows telophase I, forming two new cells.



Meiosis I

makes two cells, called **daughter cells**, each of which has 46 chromosomes (in humans) .

The daughter cells have sets of chromosomes and alleles that are different from each other and from the diploid cell that started meiosis I.

Meiosis II

The two cells produced by meiosis I undergo a second meiotic division.

However neither cell replicates its chromosomes before meiosis II.

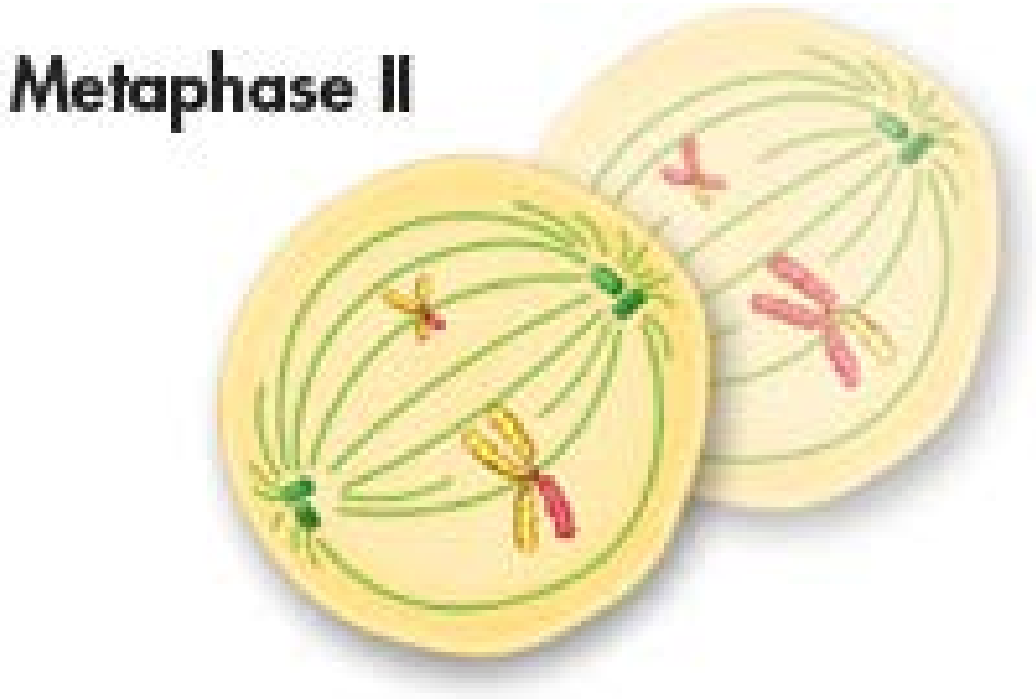
Prophase II

chromosomes—each consisting of two sister chromatids—become visible.

chromosomes do not pair to form tetrads, because the homologous pairs separated during meiosis I.

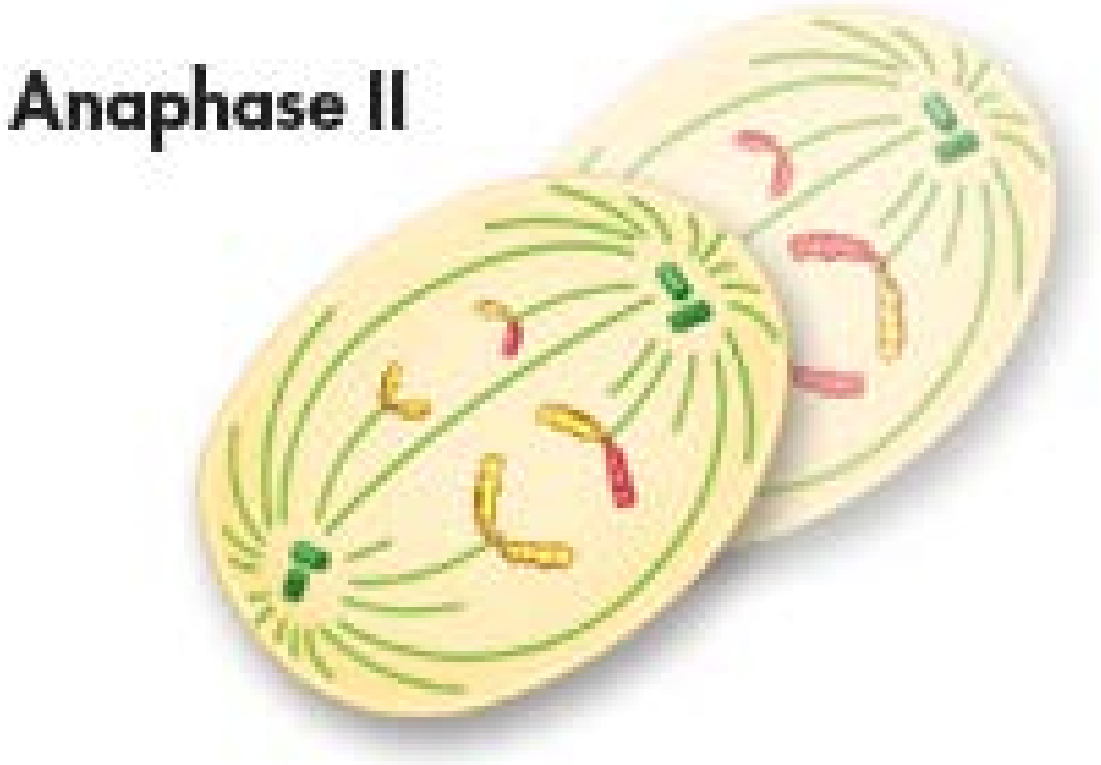
Metaphase II

chromosomes line up in the center of each cell.



Anaphase II

Sister chromatids separate.



Telophase II

Nuclear membranes begin to reform.

Cytokinesis

Cytoplasm divides to produce 4 haploid daughter cells that are also called gametes.

Male gametes are sperm. Meiosis makes 4 sperm cells in males.

In females, meiosis makes 1 egg (oocyte) and 3 polar bodies (ootids).

Only the egg is used for reproduction.

The polar bodies are either reabsorbed or eliminated from the body.

Gametes to Zygotes

Fertilization—the fusion of male and female gametes—generates new combinations of alleles in a **zygote**.

The zygote undergoes cell division by mitosis and eventually forms a new organism.

Gene Linkage

After identifying more than 50 fruit fly genes, Thomas Hunt Morgan discovered that many were “linked” together in ways that seemed to violate Mendel’s principle of independent assortment.

The linkage groups assorted independently, but all of the genes in one group were inherited together

Gene Linkage

Morgan's findings led to two remarkable conclusions:

1. each chromosome is actually a group of linked genes.

2. chromosomes assort independently, not individual genes.

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