

Sexual Reproduction & Meiosis

Chapter 11

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Overview of Meiosis

Meiosis: cell division of **gametes**

gametes: egg & sperm cells

-contain half # of chromosomes of adult body cell

Adult body cells (**somatic cells**) **diploid 2N**,

2 sets of chromosomes

Gametic cells: **haploid 1N**, only 1 set of chromosomes

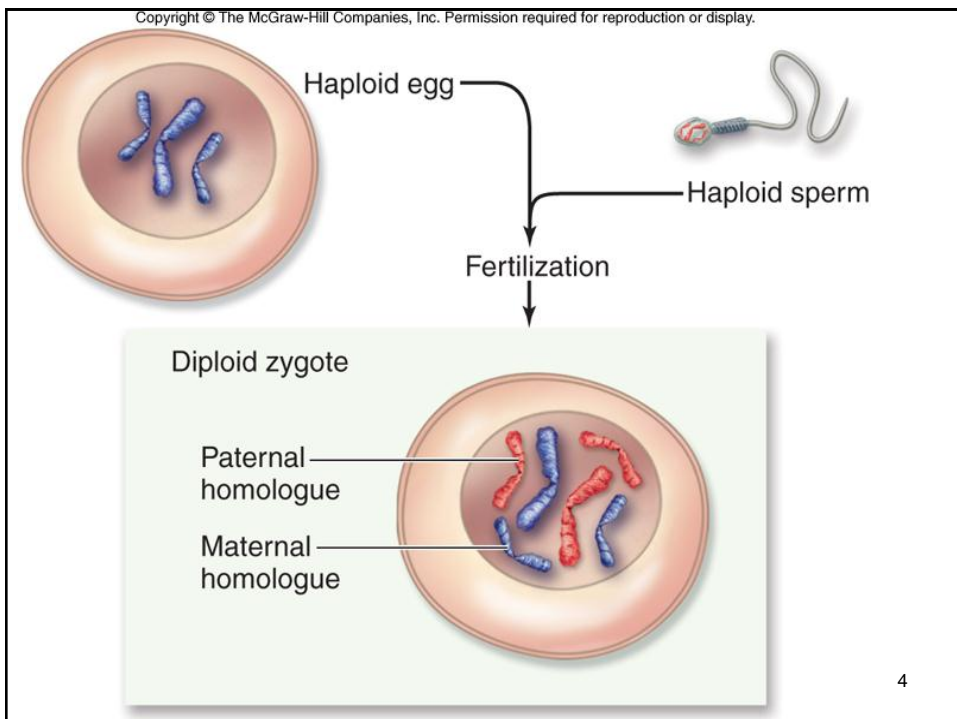
Overview of Meiosis

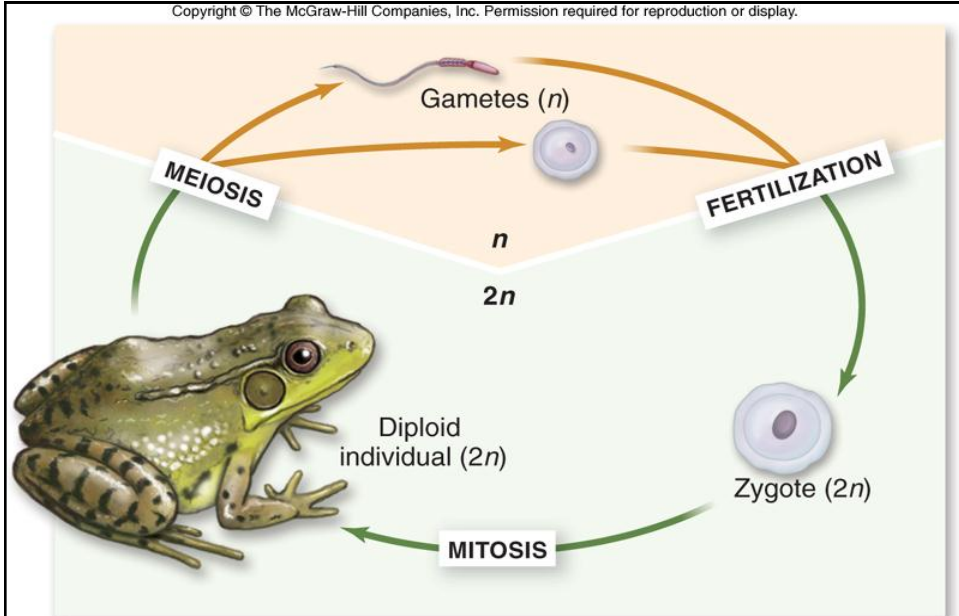
Sexual reproduction: fusion of gametes
(**fertilization**) to produce a diploid **zygote**

Life cycles of sexually reproducing organisms
involve alternation of 1N & 2N stages

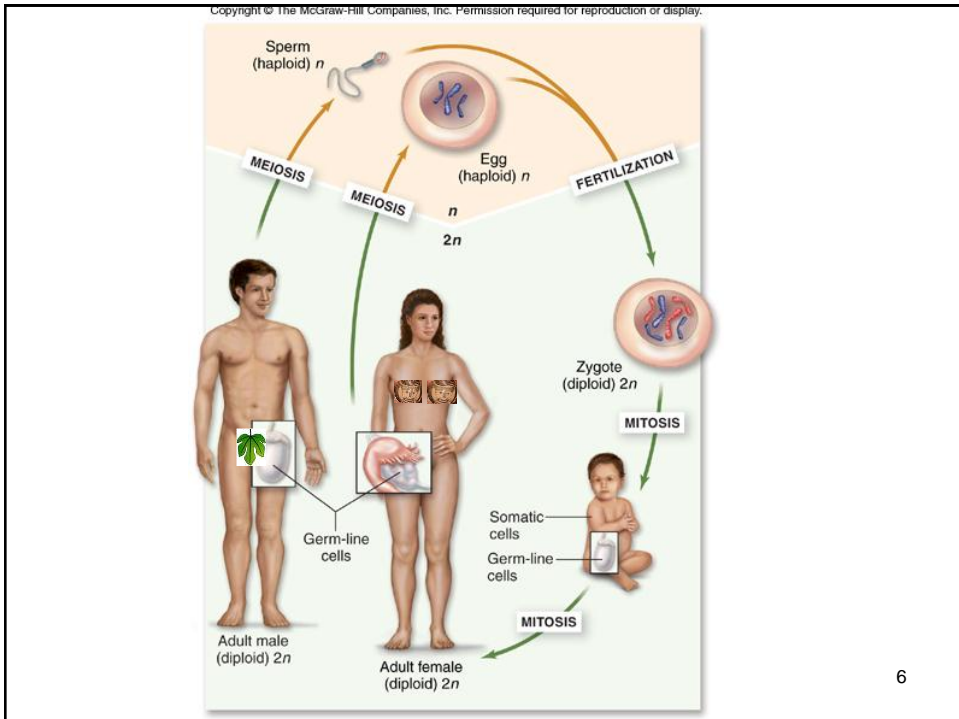
Some life cycles: longer 2N phases, some longer
1N phases

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b. Most animals



Features of Meiosis

Meiosis: two rounds of division

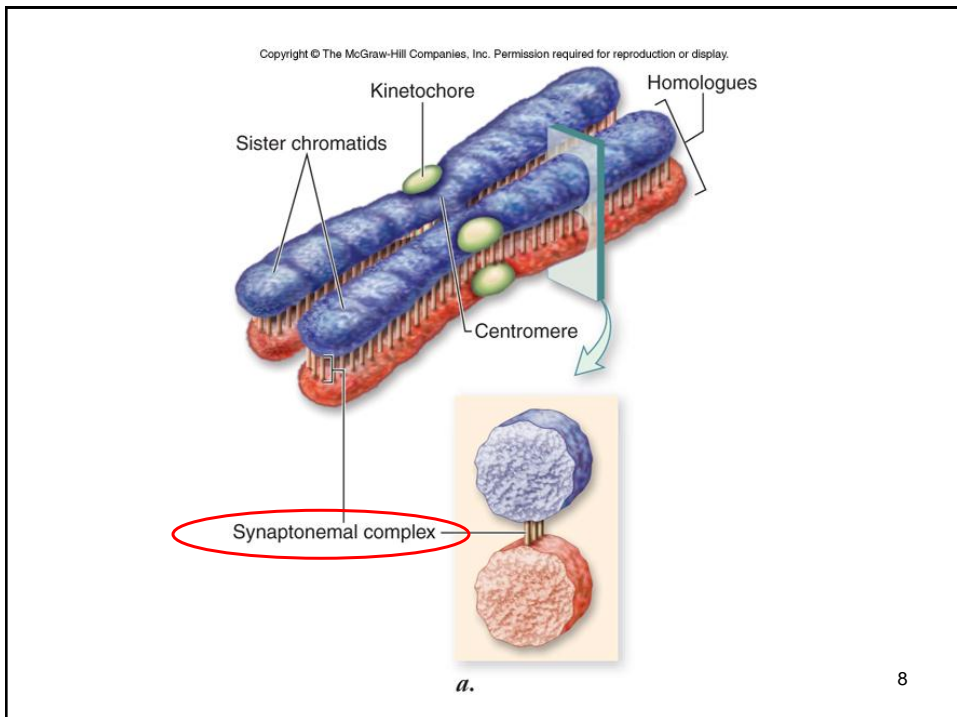
- 1) **meiosis I**
- 2) **meiosis II**

Meiosis I

homologous chromosomes (**homologues**)
closely associated with each other → **synapsis**

Proteins between homologues hold →
synaptonemal complex

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Features of Meiosis

Crossing over: genetic recombination between non-sister chromatids

-physical exchange of regions of chromatids

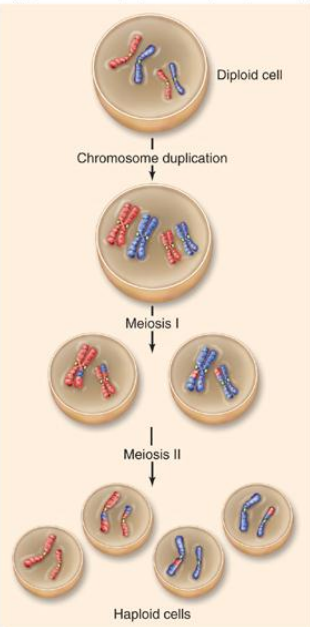
chiasmata: sites of crossing over

Homologues separate from one other in **anaphase I**

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Features of Meiosis

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Meiosis: 2 successive cell divisions with no replication of genetic material between them

Results in reduction of chromosome # from 2N to 1N

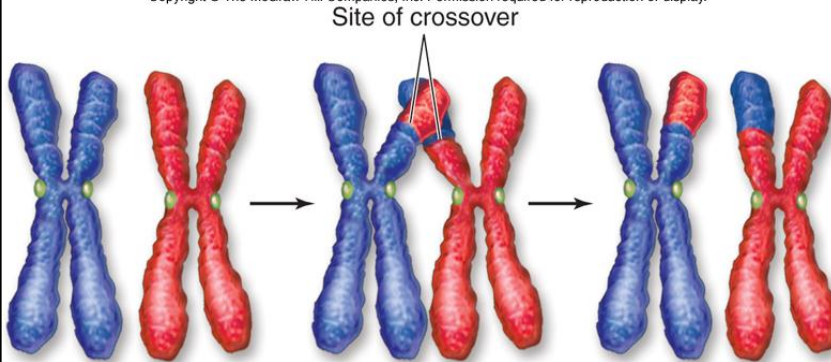
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Process of Meiosis

Prophase I:

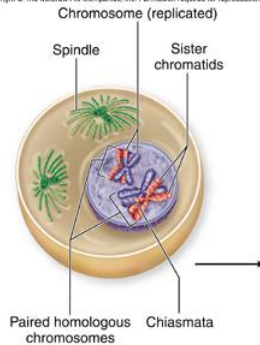
- chromosomes coil tighter
- nuclear envelope dissolves
- homologues closely associated in synapsis
- crossing over occurs between non-sister chromatids

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In prophase I of meiosis I, the chromosomes begin to condense, and the spindle of microtubules begins to form. The DNA has been replicated, and each chromosome consists of two sister chromatids attached at the centromere. In the cell illustrated here, there are four chromosomes, or two pairs of homologues. Homologous chromosomes pair up and become closely associated during synapsis. Crossing over occurs, forming chiasmata, which hold homologous chromosomes together.

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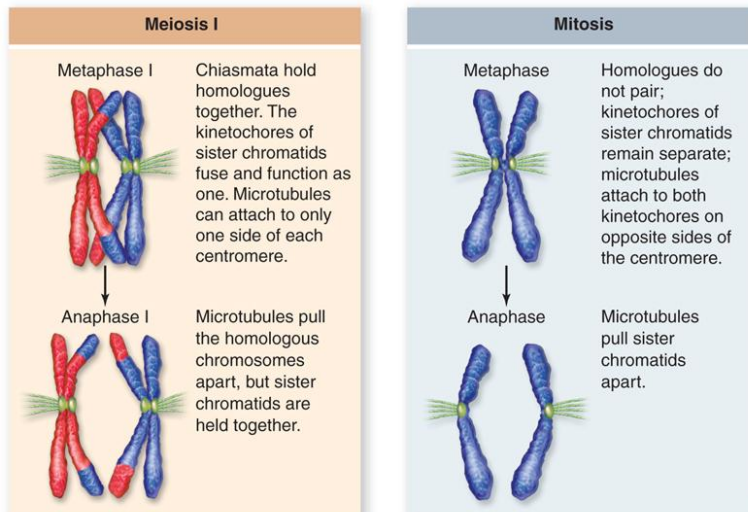
Process of Meiosis

Metaphase I:

- terminal chiasmata hold homologues together following crossing over
- microtubules from opposite poles attach to each *homologue*, not each sister chromatid
- homologues aligned at **metaphasic plate** side-by-side
- random** orientation of each homologues pair on spindle

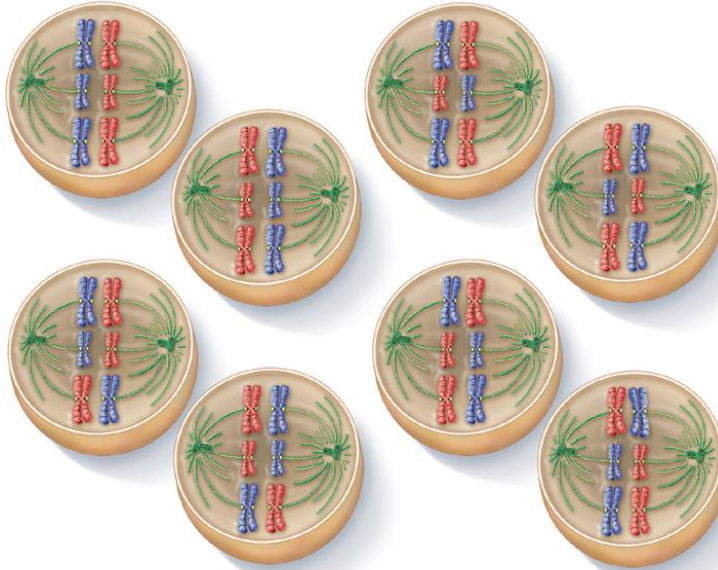
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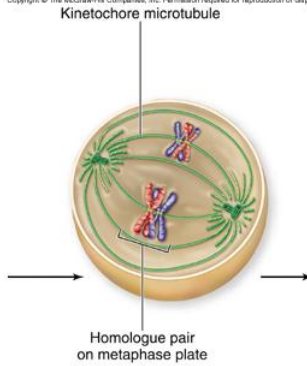
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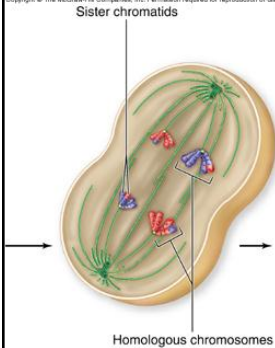


In metaphase I, the pairs of homologous chromosomes align along the metaphase plate. Chiasmata help keep the pairs together and produce tension when microtubules from opposite poles attach to sister kinetochores of each homologue. A kinetochore microtubule from one pole of the cell attaches to one homologue of a chromosome, while a kinetochore microtubule from the other cell pole attaches to the other homologue of a pair.

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Process of Meiosis

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Anaphase I:

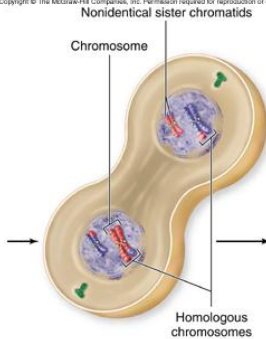
- microtubules of spindle shorten
- homologues separated from each other
- sister chromatids remain attached at centromeres

In anaphase I, kinetochore microtubules shorten, and homologous pairs are pulled apart. One duplicated homologue goes to one pole of the cell, while the other duplicated homologue goes to the other pole. Sister chromatids do not separate. This is in contrast to mitosis, where duplicated homologues line up individually on the metaphase plate, kinetochore microtubules from opposite poles of the cell attach to opposite sides of one homologue's centromere, and sister chromatids are pulled apart in anaphase.

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Process of Meiosis

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Telophase I:

- nuclear envelopes form around each set of chromosomes
- each new nucleus now haploid
- sister chromatids no longer identical because of crossing over

In telophase I, the separated homologues form a cluster at each pole of the cell, and the nuclear envelope re-forms around each daughter cell nucleus. Cytokinesis may occur. The resulting two cells have half the number of chromosomes as the original cell: In this example, each nucleus contains two chromosomes (versus four in the original cell). Each chromosome is still in the duplicated state and consists of two sister chromatids, but sister chromatids are not identical because crossing over has occurred.

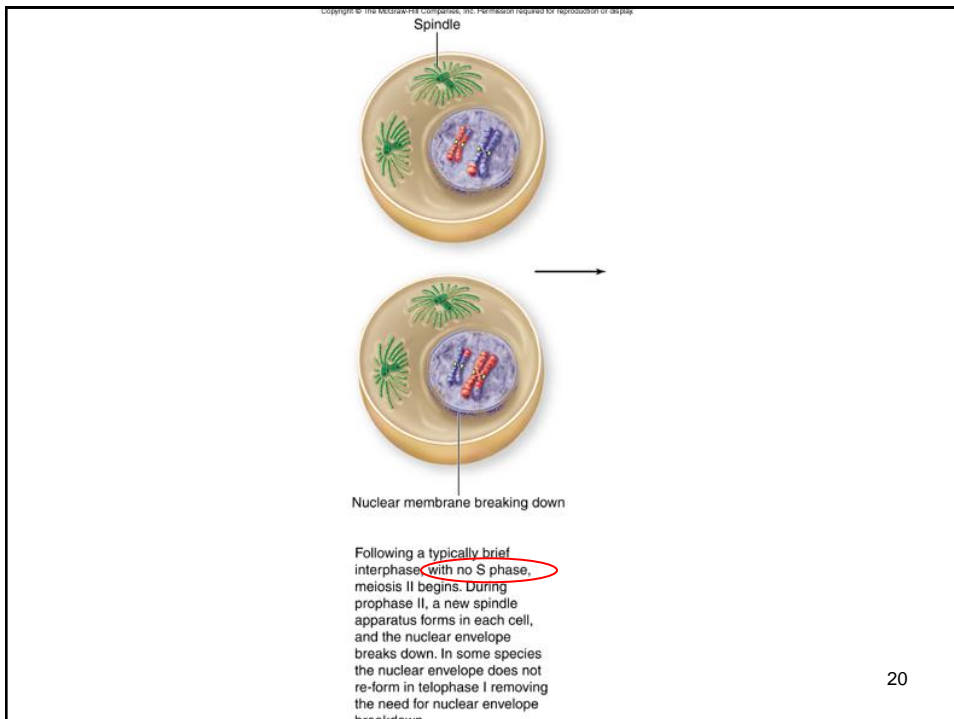
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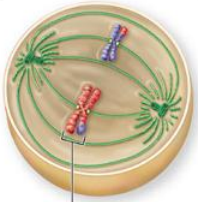
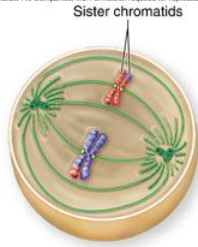
Process of Meiosis

Meiosis II resembles **mitotic division**:

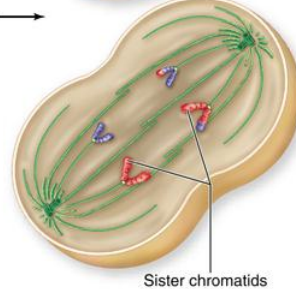
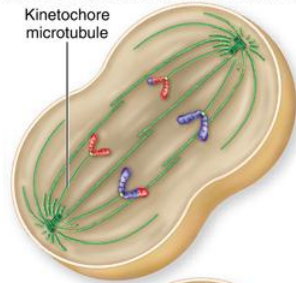
- prophase II: nuclear envelopes dissolve & spindle apparatus forms
- metaphase II: chromosomes align on metaphasic plate
- anaphase II: sister chromatids separated from each other
- telophase II: nuclear envelope re-forms; cytokinesis follows

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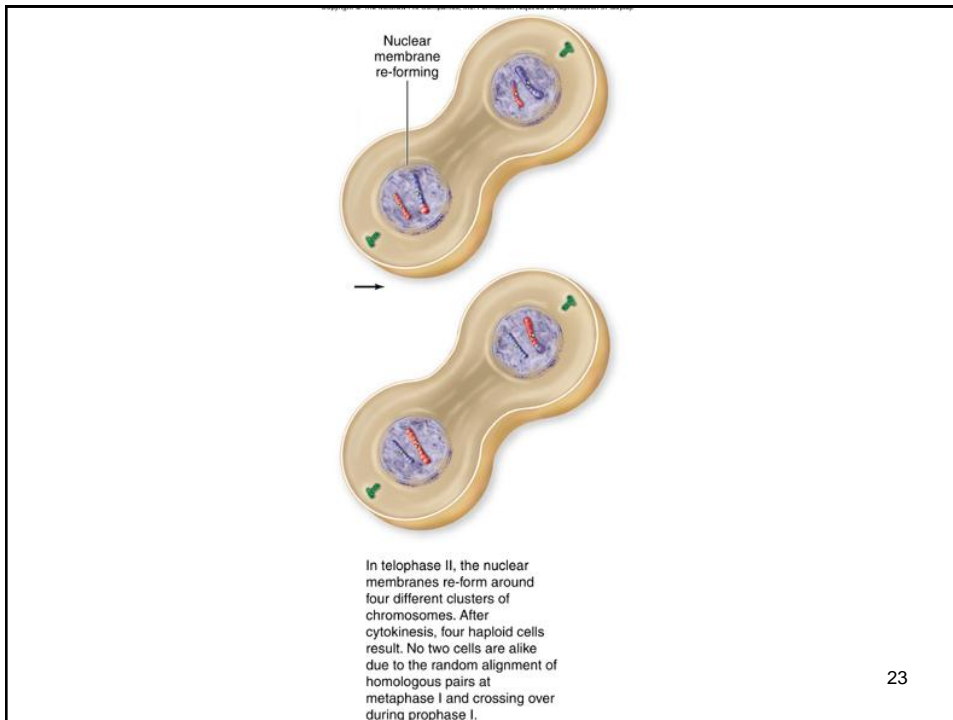




In metaphase II, a completed spindle apparatus is in place in each cell. Chromosomes consisting of sister chromatids joined at the centromere align along the metaphase plate in each cell. Now, kinetochore microtubules from opposite poles attach to kinetochores of sister chromatids.



When microtubules shorten in anaphase II, the centromeres split, and sister chromatids are pulled to opposite poles of the cells.



Meiosis vs Mitosis

Meiosis characterized by 4 features:

1. Synapsis & crossing over
2. Sister chromatids remain joined at centromeres throughout meiosis I
3. Kinetochores of sister chromatids attach to same pole in meiosis I
4. DNA replication suppressed between meiosis I & meiosis II

Meiosis vs Mitosis

Meiosis: **haploid cells** not identical to each other

Genetic differences arise from:

- crossing over
- random alignment of homologues in metaphase I (independent assortment)

Mitosis: **2 diploid cells** identical to each other

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