

Chapter 6 Meiosis and Mendel

Section 6. 1 Chromosomes and Meiosis

I. You have body cells and gametes

- * Organisms have *tens of thousands* of genes that determine individual traits.

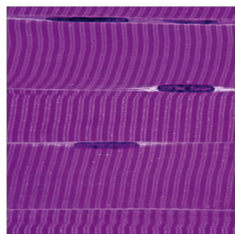
Humans have 20,000-25,000.

- * Genes are lined up on *chromosomes*.
- * A chromosome can contain a thousand or more genes along its length.

A. You have body cells and gametes.

1. Body cells are also called *somatic* cells.
2. *Germ cells* develop into gametes.
 - a. are located in the *ovaries and testes*.
 - b. Gametes are sex cells: *egg and sperm*.
 - c. Gametes have *DNA* that can be passed to offspring.

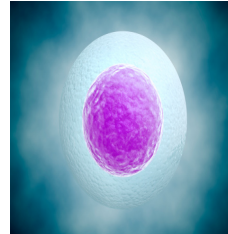
body cells



sex cells (sperm)



sex cells (egg)



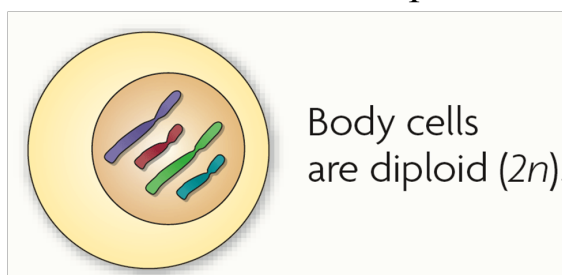
B. Your cells have autosomes and sex chromosomes.

1. Your somatic cells have **23 pairs** of chromosomes.
2. **Homologous pairs** of chromosomes have the same structure.
 - For each homologous pair, **one chromosome** comes from each parent.
3. Chromosome pairs 1-22 are **autosomes**.
 - For each autosomal pair, the **same traits** are coded for from each parent.
4. Sex chromosomes or pair 23, **X and Y**, determine gender in mammals.



C. Body cells are diploid; gametes are haploid.

1. **Fertilization** between egg and sperm occurs in sexual reproduction.
2. **Diploid (2n)** cells have two copies of every chromosome.
 - a. **Somatic** cells are diploid.
 - b. **Half** the chromosomes come from each parent.



3. **Haploid (n)** cells have one copy of every chromosome.
 - a. **Gametes** are haploid.
 - b. Gametes have **22** autosomes and **1** sex chromosome.



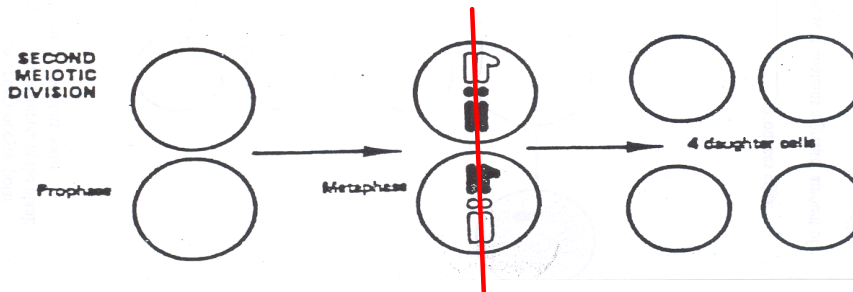
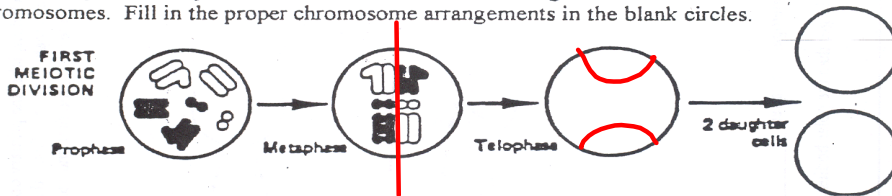
4. **Chromosome** number must be maintained in animals.
5. Many plants have more than **two copies** of each chromosome.
6. **Mitosis and meiosis** are types of nuclear division that make **different** types of cells.
7. Mitosis makes more **diploid cells**
8. Meiosis makes **haploid cells from diploid cells**.
 - a. Meiosis occurs in sex or **germ** cells.
 - b. Meiosis produces **gametes**.

MITOSIS		MEIOSIS	
	Produces genetically identical cells	Produces genetically unique cells	
	Results in diploid cells	Results in haploid cells	
	Takes place throughout an organism's lifetime	Takes place only at certain times in an organism's life cycle	
	Involved in asexual reproduction	Involved in sexual reproduction	

III.
second meiotic division

Question

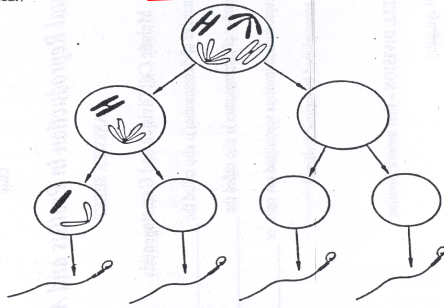
The drawings below represent meiotic cell division in an organism with six chromosomes. Fill in the proper chromosome arrangements in the blank circles.



GAMETOGENESIS
IV.
spermatogenesis

Questions

1. In the diagram below, label the following: primary spermatocyte, secondary spermatocyte, spermatid, and mature sperm. Fill in the missing chromosomes in the blank circles below, and indicate where the first and second meiotic divisions occur.



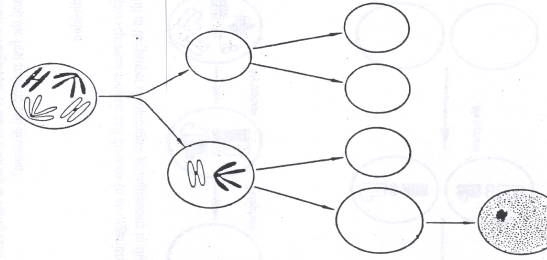
2. Label the parts indicated on the diagram of a sperm below.



V.
oogenesis

Questions

1. In the diagram below, label the primary oocyte, the secondary oocyte, polar bodies, ootid, and mature ovum. Draw the missing chromosomes in the blank circles, and indicate where the first and second meiotic divisions occur.



2. A type of gametogenesis called _____ produces eggs.

3. The ovum is larger than the polar bodies because it contains a greater amount of _____.

Section 6.2 Process of Meiosis

I. Cells go through two rounds of division in meiosis

A. Meiosis = cell division which produces **gametes with half** the chromosome number as the parent **germ cell**.

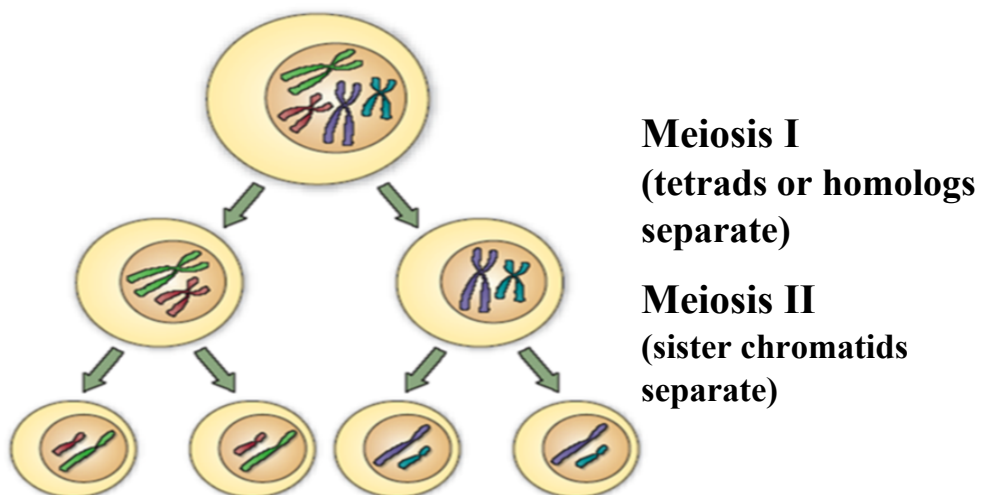
1. Meiosis occurs in the **specialized sex cell (germ cell)** of each parent.
2. Meiosis consists of two separate divisions
 - a. Meiosis I - **homologous** chromosomes are divided
 - b. Meiosis II - **sister chromatids (no longer identical)** are divided
3. Meiosis I begins with one **diploid (2n)** cell, by the **end** of Meiosis II there are four **haploid (n)** cells.

B. Homologous chromosomes & Sister Chromatids

1. The two chromosomes of each pair in a diploid cell are called **homologous** chromosomes or **homologs** .
 - a. Each of a pair of **homologs** has genes for **the same traits** .
 - b. On homologous chromosomes, these genes are **arranged** in the same order, but because there are **different possible alleles** for the same gene, the two chromosomes in a homologous pair **do not always express** the same trait **in the same way** .
 - c. Homologs are separated during **Meiosis I** .

2. Duplicated chromosomes that are attached at the centromere are called **sister chromatids**.

*Chromatids are separated by their centromere during **Meiosis II**.



II. The Phase of Meiosis

- * During meiosis, *a spindle forms and cytoplasm divides* in the same ways they do during mitosis.
- * What happens to the chromosomes in meiosis is very *different*.

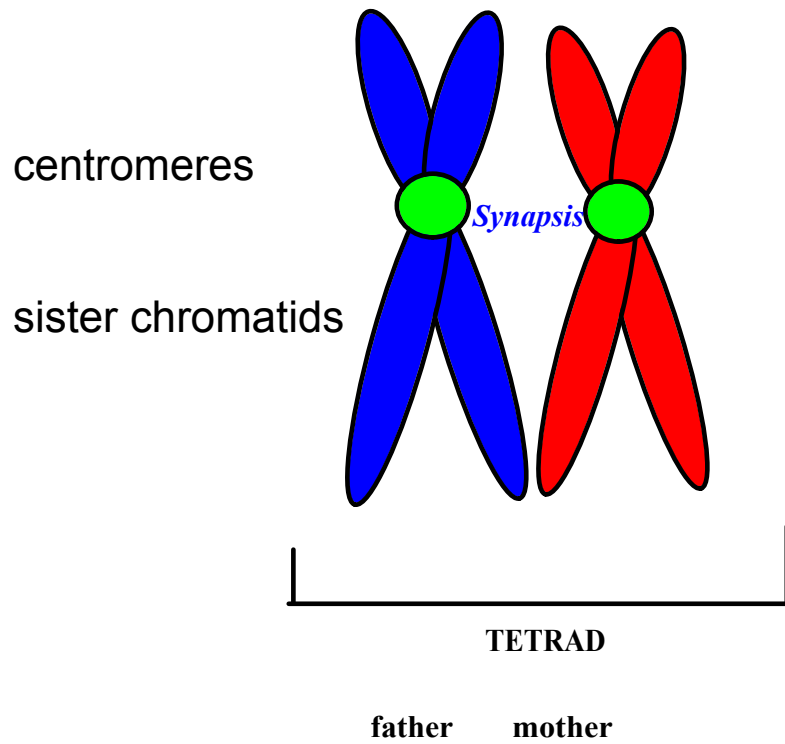
A. Interphase

- * The chromosomes are *replicated*.
- * After replication each chromosome consists of two identical sister *chromatids*, held together by a *centromere*.

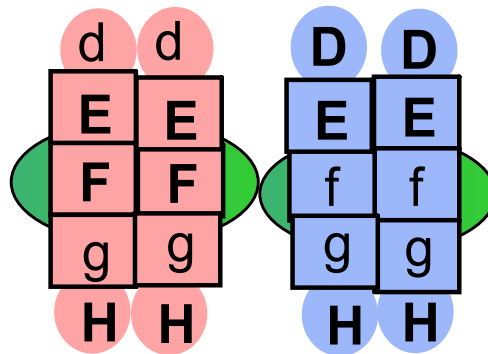
B. Prophase I

- * DNA *supercoils* or condense.
- * Homologous chromosomes line up with each other, to form a four-part structure called a *tetrad (at the synapsis)*.
- * The chromatids in a tetrad pair tightly, so tightly that *non-sister* chromatids can actually break and exchange genetic material in a process called *crossing over or crossover*.
- * Crossing over results in new combinations (*or recombination*) of alleles on chromosomes.

Meiosis



Genetic recombination
Crossing over



C. Metaphase I

- * Centromeres, of each chromosome, become attached to a *spindle fiber* .
- * The spindle fibers pull the *tetrads into the middle* (this is unique to meiosis).
- * Note that **homologous chromosomes are lined up side by side as tetrads** .(In *mitosis* they line up on the equator *independently* of each other.)

D. Anaphase I

- * Homologous chromosomes separate and *move to opposite ends of the cell* .
- * This occurs because the *centromeres* holding the sister chromatids together *do not split* .
- * This ensures that each new cell will receive only **one chromosome from each homologous pair** .

E. Telophase I/ Prophase II (in some cases)

- * Chromosomes *uncoil* & cytoplasm divides to yield two new cells.

F. The Phases of Meiosis II

*The second division in meiosis is simply a division of the products of meiosis.

mitotic

***Meiosis II consists of**

1. Prophase II
2. Metaphase II
3. Anaphase II
4. Telophase II

*The events of meiosis II are identical to those you studied in **mitosis** except that the chromosomes **replicate** before they divide at the centromeres.

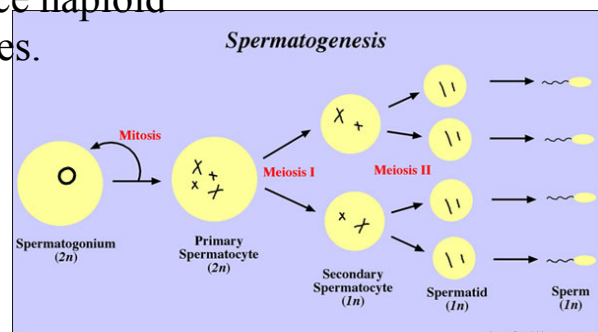
do not

G. At the end of meiosis II, **four haploid** cells have been formed from **one diploid** cell.

*These haploid cells will become **gametes**, in the process called **gametogenesis**.

1. Spermatogenesis

In males, meiosis takes place **after** puberty. Diploid cells within the testes undergo meiosis to produce haploid sperm cells with **23** chromosomes.



2. *Oogenesis*

In females, meiosis begins during the *fetal* stage when a series of diploid cells enter Meiosis I. At the conclusion of meiosis I, the process stops, and the cells gather in the ovaries. (So a female is born with *all the eggs* she is going to have in her lifetime.)

At puberty, meiosis *resumes* and one cell left at the end of Meiosis I will enter *Meiosis II* each month.

A single *haploid* egg cell is produced and the other three haploid cells *disintegrate*.

STOP

