

Chromosomes and Meiosis Interactive Reader

Chromosomes and Meiosis

Key Concept: Gametes have half the number of chromosomes that body cells have.

You have body cells and gametes.

All of the cells in your body can be divided into two groups: SOMATIC and GERM CELLS.

- **Germ cells** are the cells in your reproductive organs – ovaries or testes – that develop into eggs or sperm
- **Somatic cells**, or body cells, are all the other cells in your body.

Somatic cells make up most of your tissues and organs. The DNA in your somatic cells will not be passed on to your children. ONLY the DNA in the egg or sperm cells gets passed on to offspring. Egg cells and Sperm cells are called **Gametes**.

Each species has a characteristic number of chromosomes per cell.

For Example:

- **Humans** have 23 pairs of chromosomes. In other words there are $23 \times 2 = 46$ chromosomes in ALL body cells.
- **Fruit Flies** have 4 pairs of chromosomes or 8 chromosomes per cell.
- **Yeast** have 16 pairs of chromosomes or 16 chromosomes per cell.

The organism currently know to have the most chromosomes is a fern. It has MORE than **1200** chromosomes! Chromosome number is not related to the size or complexity of an organism.

Do gametes come from germ cells or somatic cells?

Your cells have autosomes and sex chromosomes.

Suppose you had 23 pairs of gloves. You would have a total of $23 \times 2 = 46$ gloves. You could divide them into two sets: 23 right handed and 23 left handed gloves. Similarly, your body cells have 23 pairs of chromosomes for a total of 46. These can be divided into two sets: **23 from mom and 23 from dad**. Just as you use both gloves if it is cold outside, your cells use both sets of chromosomes to function properly.

Each pair of chromosomes is called a **Homologous Pair**. Here, *homologous* means having the SAME structure. **Homologous Chromosomes** are two chromosomes—one from mom and one from dad—that are the same size and have copies of the same genes. Although each chromosome in a homologous pair has copies of the same genes, the two copies may differ. For Example: each gene in the pair may influence eye color. The gene on one may lead to brown eyes while the other codes for blue eyes.

One of your 23 pairs of chromosomes is your pair of **Sex Chromosomes**. These chromosomes control the sex of an organism.

Humans and ALL mammals have two different sex chromosomes – X and Y.

- Females have 2 X chromosomes (XX).
- Males have one X chromosome and one Y chromosome (XY)

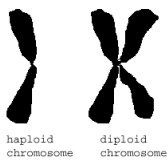
The other 22 pairs of chromosomes are called **Autosomes**. These chromosomes contain the genes for all the rest of an organism's life functions.

If a person's pair of sex chromosomes is XY, is the person male or female?

Body cells are diploid; gametes are haploid.

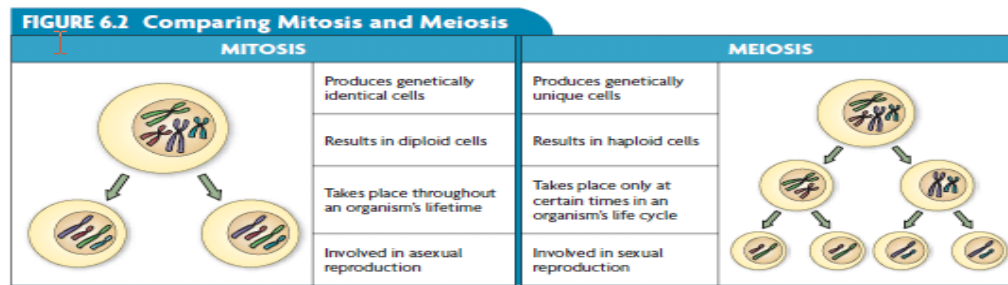
Sexual Reproduction involves two gametes—an egg and a sperm-joining together. **Fertilization** happens when the egg and sperm actually combine. The nucleus of the egg combines with the nucleus of the sperm to form ONE nucleus. This new nucleus must have the correct number of chromosomes -46- for humans. Therefore, the egg and sperm must each have HALF the number of chromosomes -23- for humans.

Diploid and Haploid Cells



Gametes-egg and sperm-are **Haploid** cells. Haploid cells contain ONE copy of each chromosome (23 for humans). A sperm and egg join together to form a **Diploid** cell (46 chromosomes for humans). Body cells are ALL diploid. ONLY gametes are haploid.

Meiosis



The germ cells in your reproductive organs form gametes through a process called Meiosis. **Meiosis** is a process that divides a diploid cell into a haploid cell.

Remember that mitosis results in two identical diploid cells. Mitosis is used for development, growth, and repair. In contrast, Meiosis results in 4 haploid cells that are **UNIQUE**. Meiosis only happens in germ cells to make gametes.

What is the difference between the cells that result from mitosis and the cells that result from meiosis?

Vocabulary Check

1. When the nucleus of an egg joins the nucleus of a sperm.
2. A body cell.
3. An egg or sperm cell.
4. Any chromosome except a sex chromosome.
5. If a diploid cell with 8 chromosomes goes through meiosis, how many chromosomes will the resulting haploid cells have?
6. A person with XX is _____.

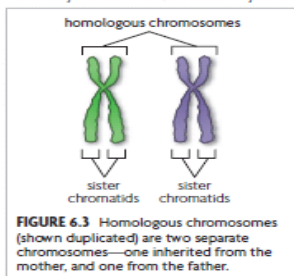
Process of Meiosis

Key Concept: During meiosis diploid cells undergo two cell divisions that result in haploid cells.

Cells go through two rounds of division in meiosis.

Meiosis begins with a diploid cell that already has copied chromosomes. There are **TWO** rounds of cell division: Meiosis I and Meiosis II. The phases are similar to the phases of mitosis. To keep the two processes separate in your mind, focus on the big picture. Mitosis results in **IDENTICAL DIPLOID CELLS** and Meiosis results in **4 UNIQUE HAPLOID CELLS**.

Homologous Chromosomes and Sister Chromatids



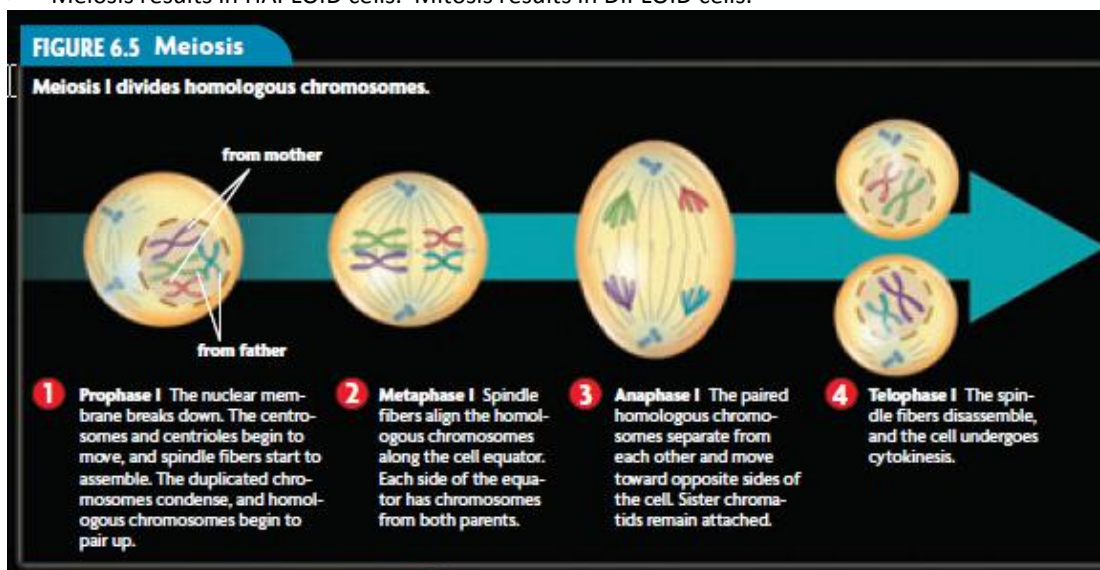
Recall that homologous chromosomes are two separate chromosomes: one from mom and one from dad. Homologous chromosomes carry the same genes in the same order. However the copies of the genes may differ. Homologous chromosomes are **NOT** copies of each other. In contrast, recall that a duplicated chromosome is made of two sister chromatids, attached at the centromere. Sister chromatids are **IDENTICAL** copies of each other.

The Process of Meiosis

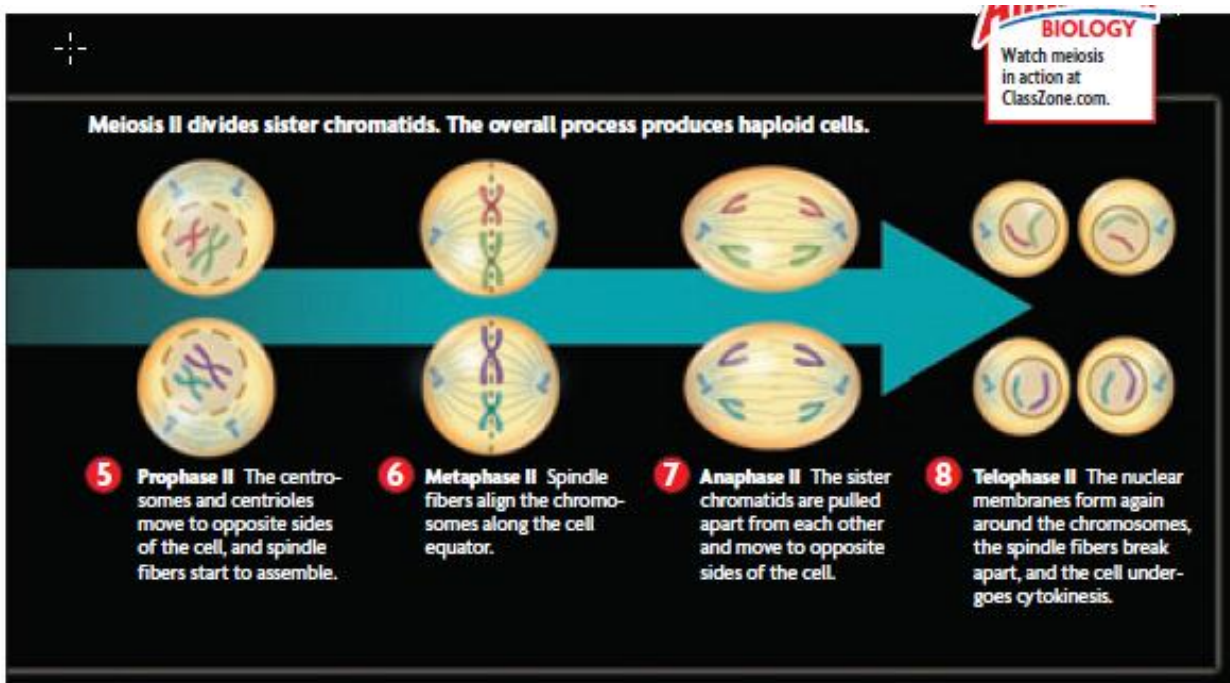
Before meiosis begins, DNA has already been copied. Homologous chromosomes are separated in the first half of meiosis – meiosis I. This results in two haploid cells with duplicated chromosomes. These cells are called haploid because they each have only **ONE** of every pair of homologous chromosomes. Sister Chromatids are separated in the second half of meiosis – meiosis II. This results in 4 haploid cells with undoubled chromosomes. Like mitosis, meiosis is described in phases.

Keep in mind the two **KEY DIFFERENCES** between mitosis and meiosis.

- Meiosis has **TWO** divisions. Mitosis only has **ONE**.
- Meiosis results in **HAPLOID** cells. Mitosis results in **DIPLOID** cells.



On the diagram above, where in the process does the cell first become haploid?



Haploid cells develop into mature gametes.

Gametogenesis is the production of gametes – eggs or sperm. Gametogenesis includes both meiosis and other changes that the haploid cells must go through. The **Sperm** cells, the male gamete, is much smaller than the **Egg**, the female gamete. After meiosis, a cell that develops into a sperm will form a compact shape with a long tail, or flagellum, that the cell uses to move. For egg production, only one of the cells from meiosis becomes an egg. It receives most of the cytoplasm and organelles. The other cells produced by meiosis become **Polar Bodies**, smaller cells that contain little more than DNA, and are eventually broken down.

ANSWER IN YOUR JOURNAL: How do mature gametes differ from the immature haploid cells?

Vocabulary Check

1. Sperm and eggs are formed through the process of _____.
2. For egg formation, one of the cells resulting from meiosis becomes an egg and others become _____.
3. What is the end result of meiosis?
4. What are two differences between meiosis and mitosis?