LECTURE (3)

Human Genetics

3rd stage

Dr. Zahraa Alzaidi

Meiosis

Meiosis is a process where a single cell divides twice to produce four cells containing half the original amount of genetic information. These cells are our sex cells – sperm in males, eggs in females.

meiosis in humans is a division process that takes us from a diploid cell—one with two sets of chromosomes—to haploid cells—one with a single set of chromosomes. When a sperm and an egg join in fertilization, the two haploid sets of chromosomes form a complete diploid set: a new genome.

Meiosis can be divided into nine stages. These are divided between the first time the cell divides (meiosis I) and the second time it divides (meiosis II):

Interphase

Before entering meiosis I, a cell must first go through interphase. As in mitosis, the cell grows during G-1 , copies all of its chromosomes during S phase, and prepares for division during G-2 phase.

Meiosis I

Meiosis 1 contain 4 stages (prophase I, metaphase I, anaphase I, telophase I)

- **Prophase I**

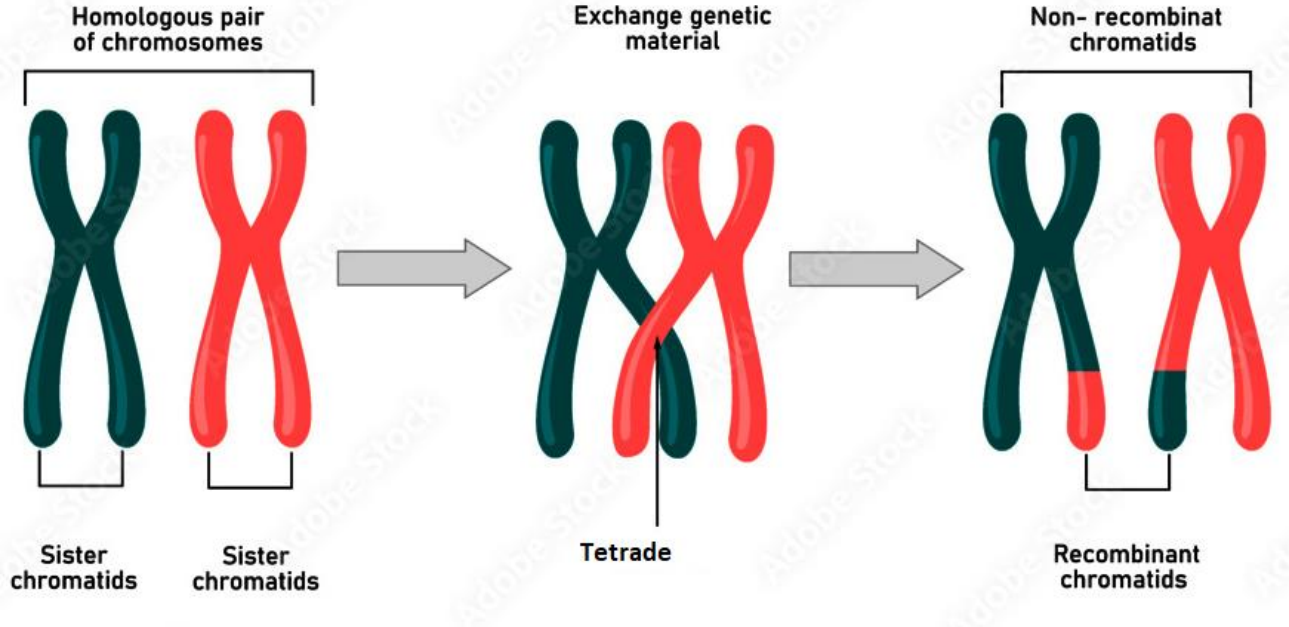
  1- The copied chromosomes condense into X-shaped structures that can be easily seen under a microscope.

  2- Each chromosome is composed of two sister chromatids containing identical genetic information.

  3- The chromosomes pair up so that both copies of chromosome 1 are together, both copies of chromosome 2 are together, and so on. In process called Synapsis to create tetrads, which are composed of two pairs of sister chromatids.

4- The pairs of chromosomes may then exchange bits of DNA in a process called recombination or crossing over between non-sister chromatids homologous chromosome .

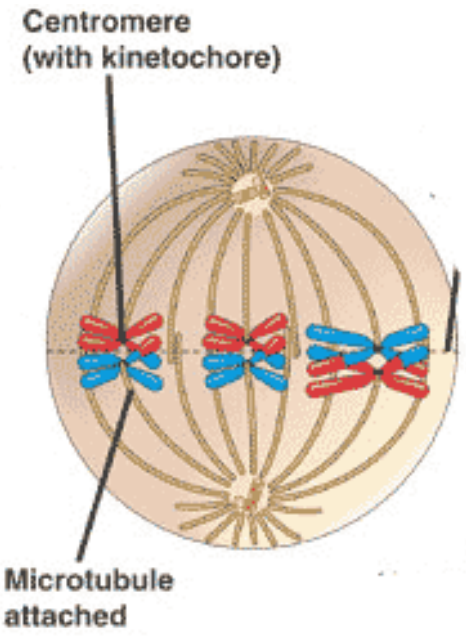
5- At the end of Prophase I the membrane around the nucleus in the cell dissolves away, releasing the chromosomes.



- **Metaphase I:**

1- The chromosome pairs line up next to each other along the center of the cell.

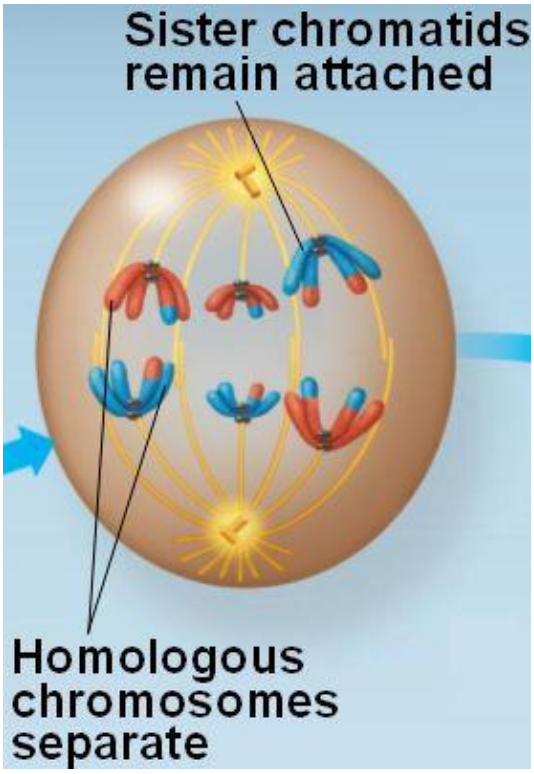
2- The meiotic spindle fibers attach to one chromosome of each pair.



- **Anaphase I:**

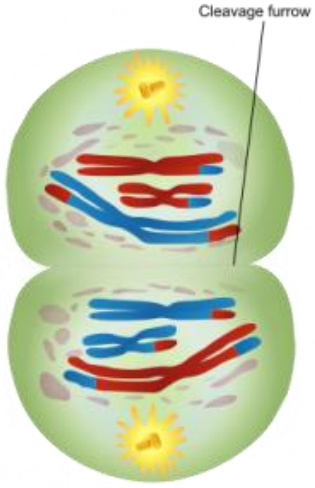
1- The pair of chromosomes are then pulled apart by the meiotic spindle, which pulls one chromosome to one pole of the cell and the other chromosome to the opposite pole

2- In meiosis I the sister chromatids stay together. This is different to what happens in mitosis and meiosis II.



- Telophase I
  1- The chromosomes complete their move to the opposite poles of the cell.
  2- At each pole of the cell a full set of chromosomes gather together

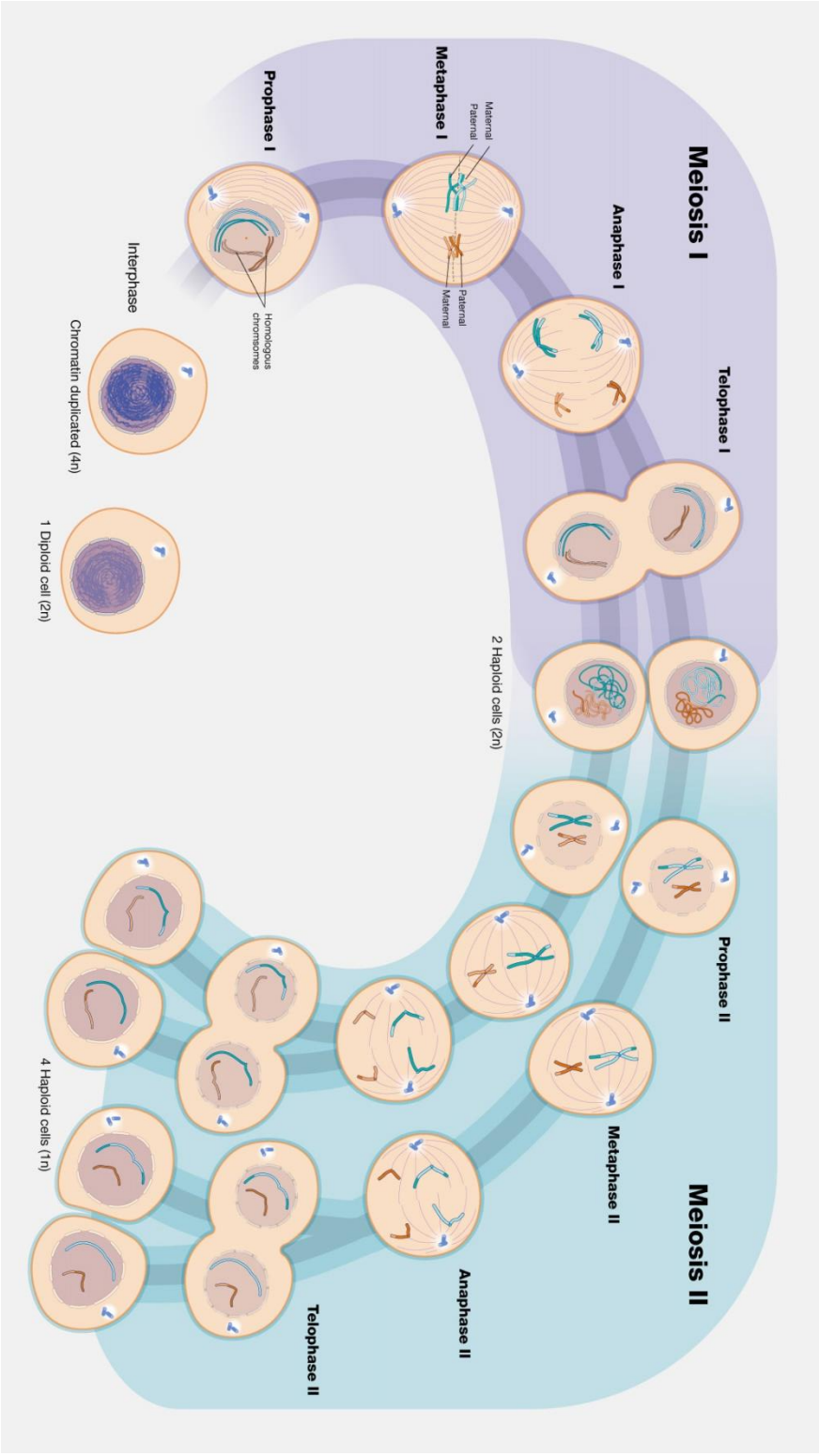
  3- The single cell then pinches in the middle to form two separate daughter cells each containing a full set of chromosomes within a nucleus. This process is known as cytokinesis.



➢ Meiosis II

After a typically brief interphase, in which no DNA synthesis occurs, the second meiotic division begins.

Meiosis II resembles a normal mitotic division. Prophase II, metaphase II, anaphase II, and telophase II



Mitosis	Meiosis
1) This division takes place in somatic cells and as a result of this division, growth occurs.	1) This takes place usually in reproductive cells and as a result of this character one generation passes into the other.
2) Completed in one stage.	2) Completed in two stages.
3) Prophase is smaller (as compared to prophase of Meiosis).	3) Prophase longer than prophase of mitosis
4) Crossing over does not take place.	4) Crossing over takes place in which the exchange of segments of chromatids occurs.
5) Synapsis does not take place at metaphase.	5) Synapsis between homologous chromosomes takes place
6) At metaphase, the centromere is towards the equatorial plate and ends of chromosomes towards poles. Centromere divides.	6) At metaphase I, the centromere is towards poles and ends of chromosomes towards the equatorial plate. Centromere does not divide.
7) Chromatids are long and thin.	7) Chromatids are shorter and thick

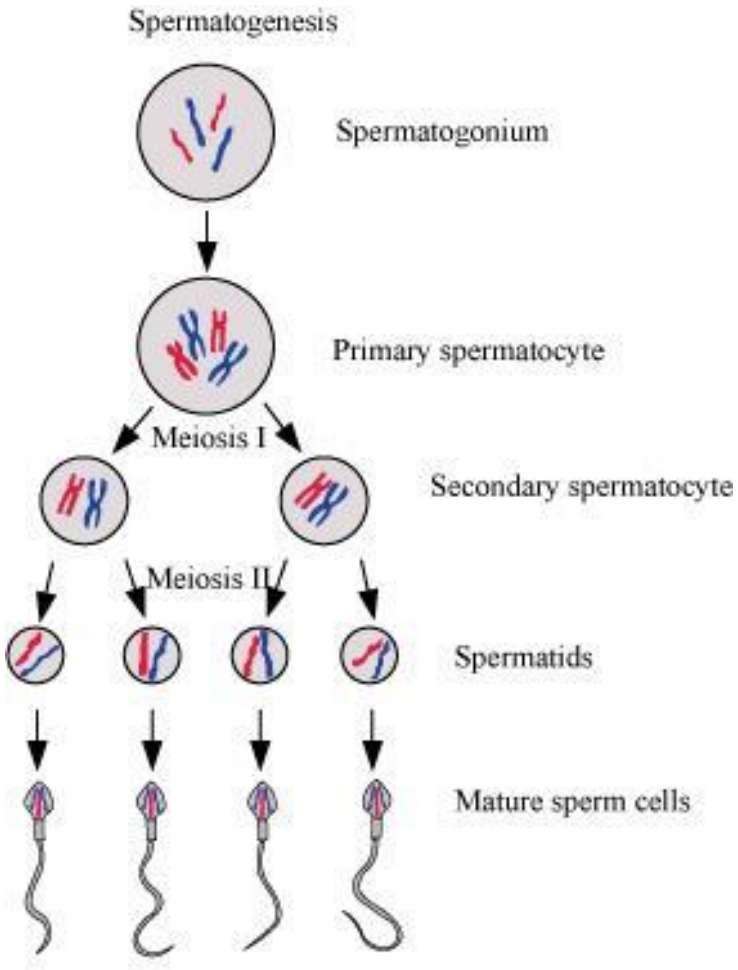
- **Gametogenesis**

  in embryology, the process by which gametes, or germ cells, are produced in an organism. The formation of egg cells, or ova, is technically called oogenesis, and the formation of sperm cells ,is called spermatogenesis.

  - **Spermatogenesis:**

    Spermatogenesis is the process by which male gametes develop from germ cells in the testes. In other words, it's how sperm is made. Humans start making sperm when they reach puberty. The process is coordinated by hormones, which act as chemical messengers that ready the body for sexual

maturity. This process involves multiple steps of cell division and differentiation, can be divided into five succesive stages: (1) spermatogonia, (2) primary spermatocytes, (3) secondary spermatocytes, (4) spermatids, and (5) spermatozoa.



Process of spermatogenesis

- **Oogenesis**

  Oogenesis is the process by which mature female gametes, or ova, develop from germ cells. Oogenesis starts with a germ cell called oogonium and undergoes mitosis and meiosis to increase in number. The process of oogenesis takes place in the following three stages:

✓ Before birth

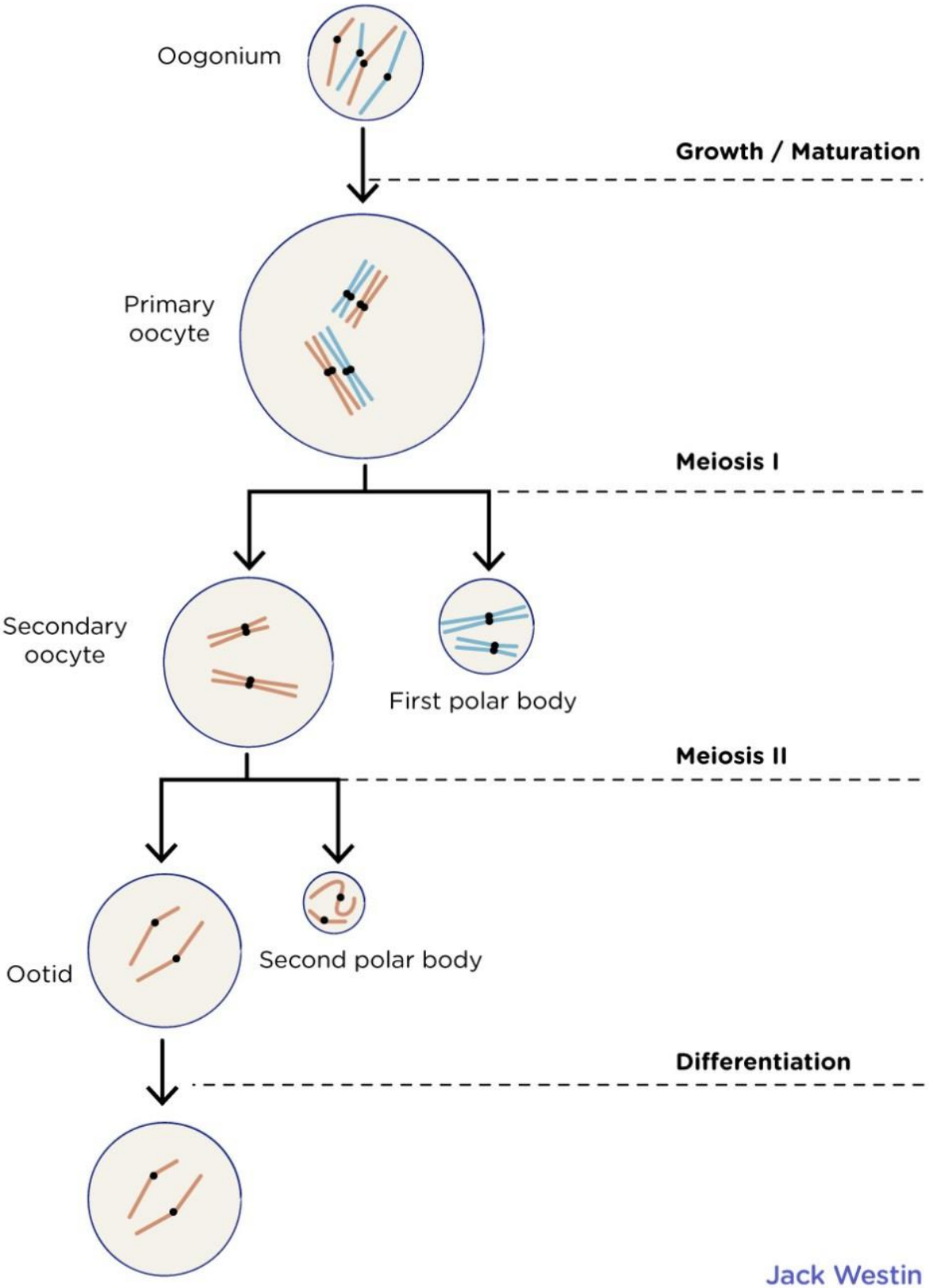
- a few million immature germ cells, or oogonia, are formed within each fetal ovary.
- some oogonia enter meiosis I, are arrested at prophase I, and are now known as primary oocytes.
- primary oocytes form primary follicles

✓ Between birth and puberty

- several of the follicles degenerate over time, leaving only a few 100,000 follicles intact by the time puberty hits.

✓ After puberty

- the primary oocyte within follicle completes its first meiotic division, producing a secondary oocyte and a first polar body.
- Secondary oocyte enter second meiotic division, producing (ootide) and second polar body. After differentiation new mature ova produced.


Oogonium
Growth / Maturation
Primary oocyte
Meiosis I
Secondary oocyte
First polar body
Meiosis II
Ootid
Second polar body
Differentiation
Jack Westin