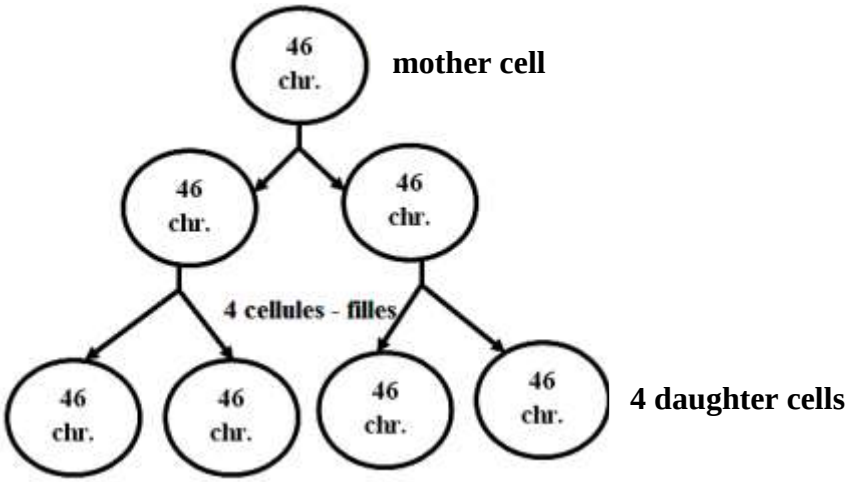
Biology Course	Chapter 8 – Transmission of the Genetic Information	Class: Grade 9

<u>Activity 1 :</u> Mitosis : Conformed Division

A- Introduction:

- In order to grow and reproduce, the human cells undergo two types of cell divisions: <u>mitosis</u> and <u>meiosis</u>.
  - **Cell division :** a phenomenon that produces two daughter cells from a mother cell.
  - **Mitosis** is a cell division where one mother cell divides into two daughter cells.

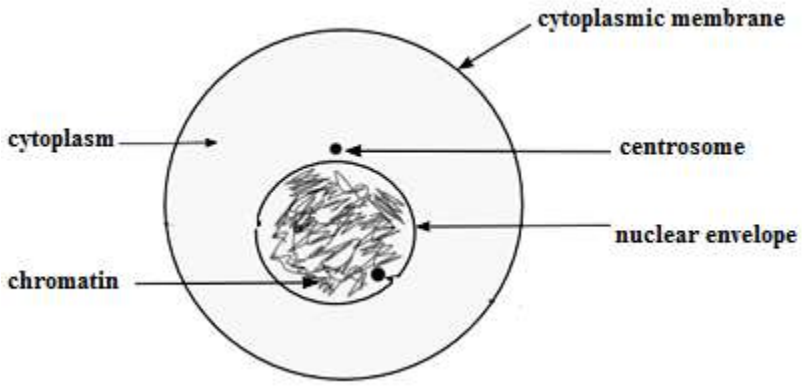
- **During mitosis**, the mother cell having 46 chr. (2n) gives 2 daughter cells having the same number of chromosomes. Therefore, the daughter cells will be identical to each other as well as their mother cell.



B- Interphase :

- **Cell Cycle** = interphase + mitosis.

- **Interphase** :
  - It is the period between two consecutive mitosis / (longest phase of a cell cycle).
  - The cell doubles its chromosomal material (**<u>duplication</u>**) and leads to the formation of chromosomes having 2 chromatids attached by a centromere.



The **chromatin** is a substance that leads to the formation of chromosomes.

It is made of DNA molecules, proteins…

C- Importance of mitosis :

Mitosis is important to our body to:

- Replace dead cells.
- Make new cells for the body to grow and develop.
- Heal a wound.

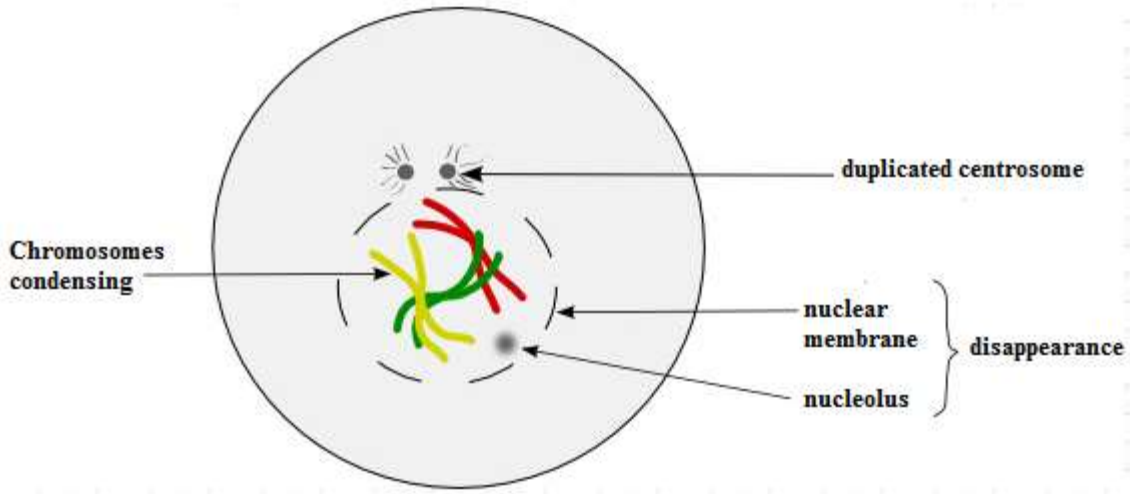
D- Phases of Mitosis :

Note : *Interphase* is not a phase of mitosis, it only prepares the cell before undergoing mitosis.

- Mitosis consists of 4 major phases:

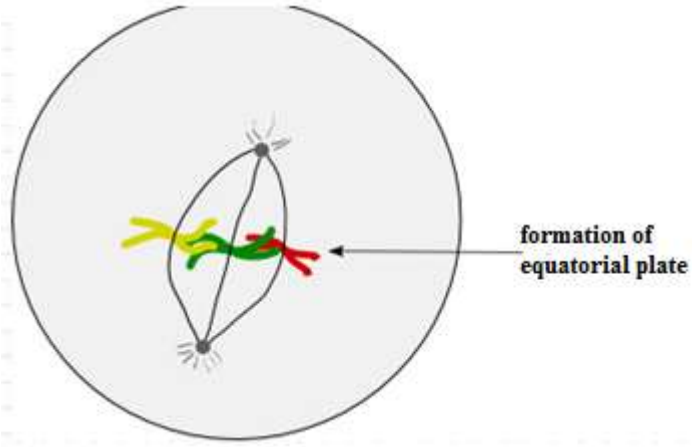
1- Prophase	2- Metaphase	3- Anaphase	4- Telophase

1- Prophase



- The chromatin condenses into chromosomes made up of 2 chromatids.
- Centrosomes duplicate and change into asters.
- The nuclear membrane disappears.
- A spindle of fibers (achromatic spindle) forms.

2- Metaphase

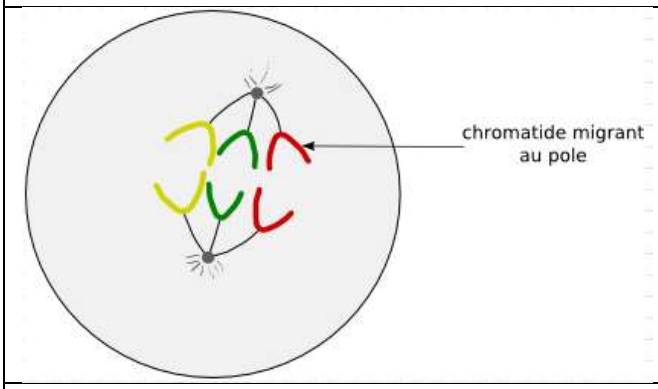


Note :

During metaphase, the chromosome is made up of 2 chromatids.

- All chromosomes are aligned at the equatorial plate.
- The chromosomes are attached to the spindle fiber by the centromeres.

3- Anaphase

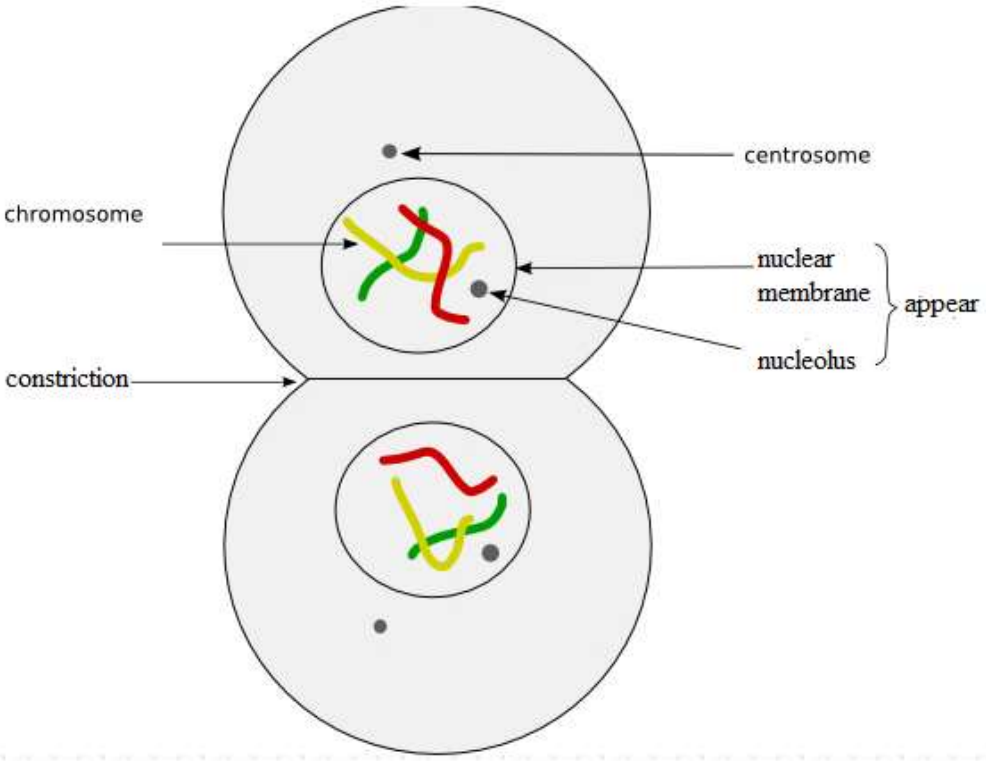


Note :

During anaphase, the chromosome is made up of 1 chromatid.

- The centromere of each chromosome divides.
- Each sister chromatid migrates to the opposite pole of the cell.
- **Polar ascension** takes place. *(Each pole receives identical set of chromosomes).*

4- Telophase



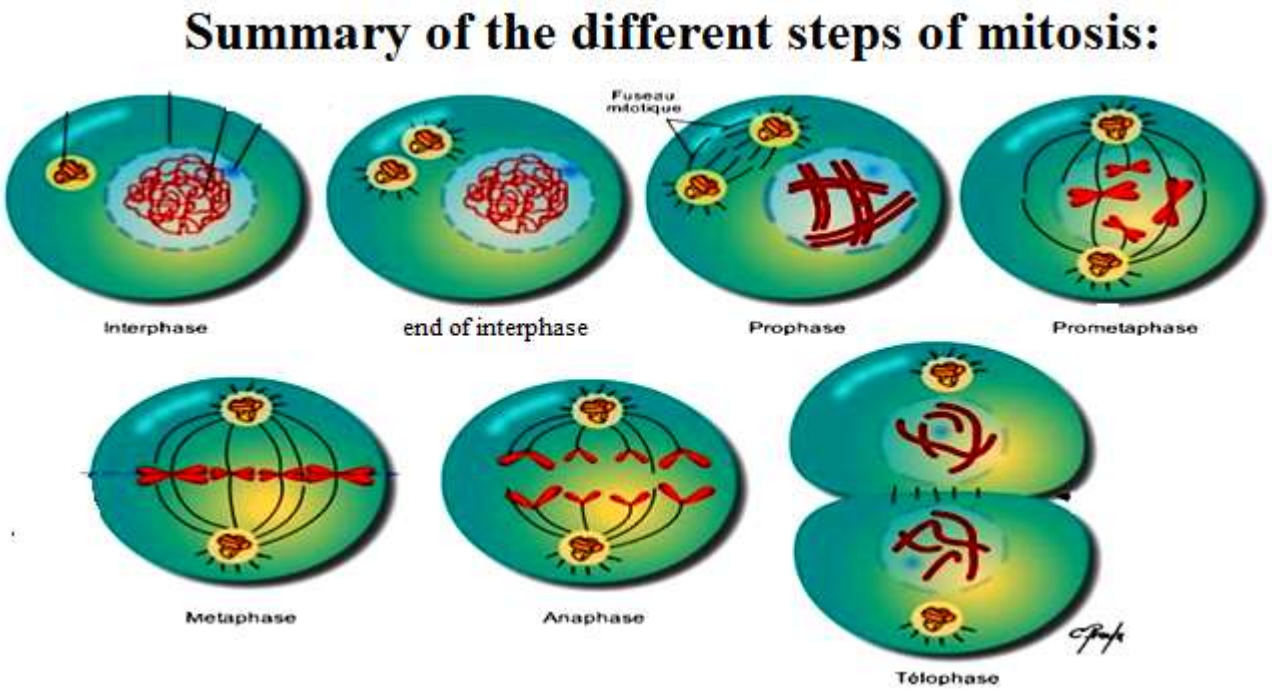
- The mother cell divides completely into two daughter cells.
- Each daughter cell receives an equal amount of cytoplasm.
- Chromosomes decondense into chromatin.
- Asters change into centrosomes.
- Nuclear membrane reappears.
- Spindle fibers disappear.

(Each daughter cell is now ready to enter interphase to grow and become a mother cell of its own.)

Activity 2 :

E- The mother cell divides into two identical daughter cells. **Each daughter cell resulting from the mitosis have the same genetic program (same karyotype) as the mother cell.** A new cycle will begin after the 1st mitosis, the cell enters in interphase and then mitosis…

F- Summary of the different steps of mitosis:



<u>Mitosis in plant cell :</u>

- It is similar to that of animal cell but plant cell doesn't contain a centrosome, thus no formation of asters during mitosis.
- During telophase, there is no constriction of the membrane.
- A cell wall is formed at the level of the equatorial plate to separate daughter cells,

<u>Activity 3</u>: Meiosis

A- Definition :

- **Meiosis** is a phenomenon characterized by 2 successive cell divisions leading to the formation of gametes. **<u>Ex</u>** : sperm cells and ova.

B- Importance of Meiosis:

- Important for the formation of gametes needed to give birth to new descendants.
- It occurs only in special organs called **<u>gonads</u>** (testicles and ovaries).
- During meiosis, each mother cell divides to give 4 daughter cells. Each daughter cell will have half the number of chromosomes (haploid) of the mother cell.

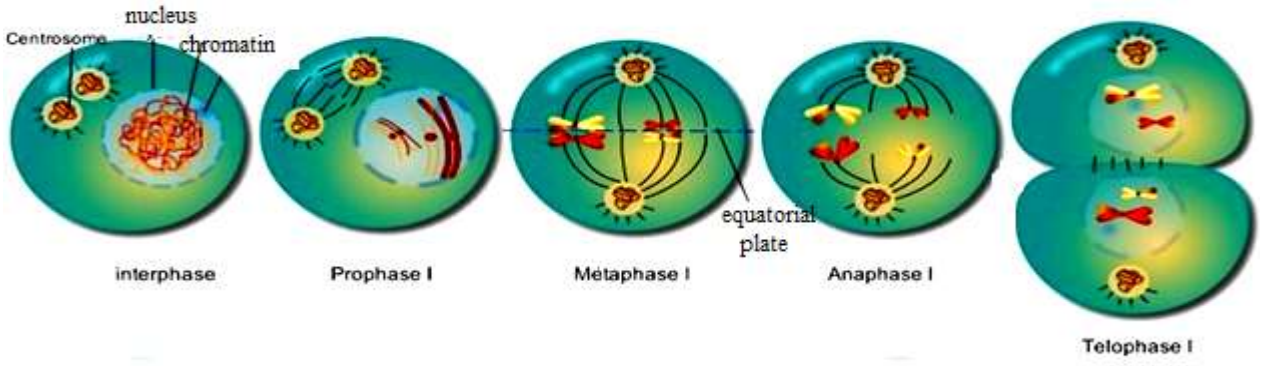
C- Steps of Meiosis:

<u>Note :</u> Before any cell division, interphase should take place to change the chromosomes from single to chr. having 2 chromatids each.

- **Meiosis =** reductional division (meiosis I) + equational division (meiosis II).

- **Reductional Division (Meiosis I) :**

  It has 4 phases: Prophase I, Metaphase I, Anaphase I, Telophase I.

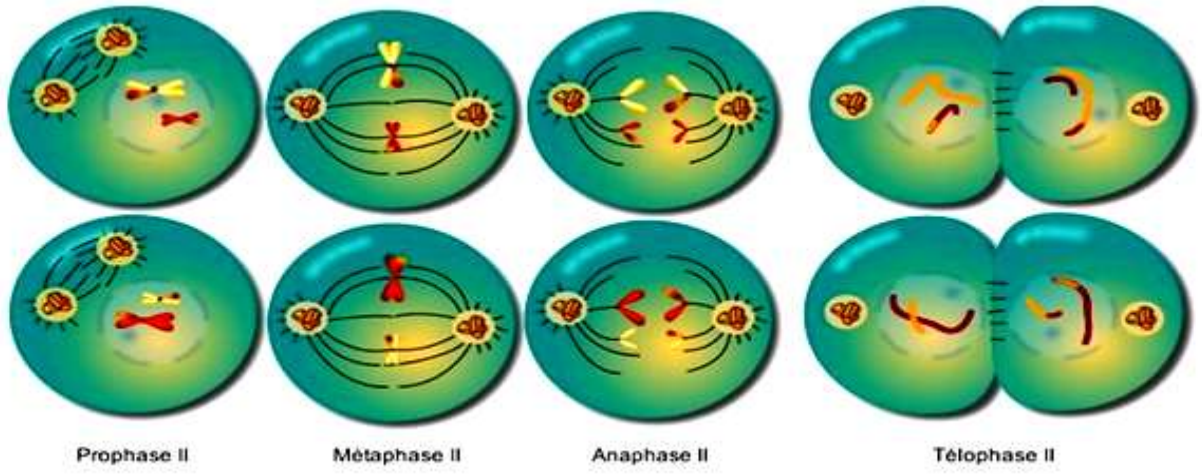


Phase	Details
Prophase I	- Condensation of chromosomes. - Disappearance of the nuclear membrane. - The homologous chromosomes paired up, forming tetrads.

Metaphase I	- Tetrads are aligned at the equatorial plate. *A tetrad is made of four simple <u>chromosomes</u>.*
Anaphase I	- Separation of homologous chromosomes (46 → 23 chr.) - Migration of chromosomes made of 2 chromatids : Polar Ascension.
Telophase I	- The resulting daughter cells will have half the number of chr. (23) as the mother cell (46). *Hence, this division is called reductional.*

- **Equational Division (Meiosis II) :**

  It has 4 phases : Prophase II, Metaphase II, Anaphase II, Telophase II.



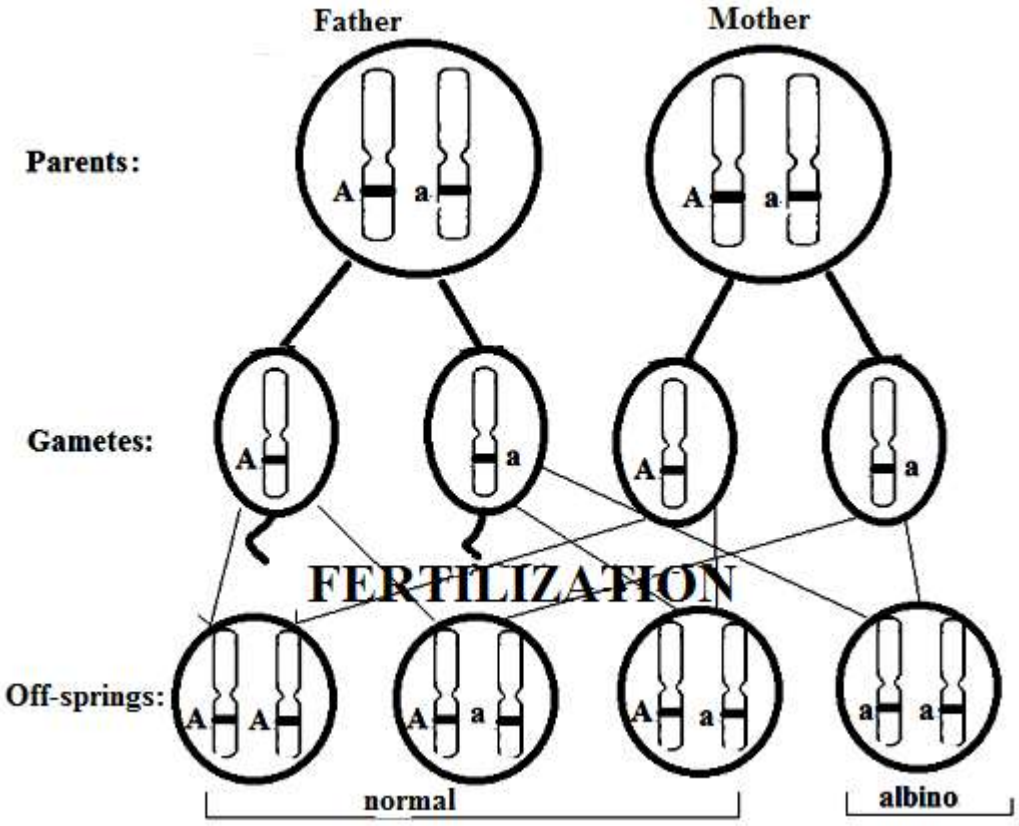
Phase	Details
Prophase II	- We see only 1 copy of each homologous chromosome (with 2 chromatids).
Metaphase II	- Chromosomes with 2 chromatids are aligned at the equatorial plate.
Anaphase II	- Migration of chromosomes with 1 chromatid. (*separation of sister chromatids).*
Telophase II	- 4 daughter cells are obtained (n = 2 chr. with 1 chromatid). *The number of chr. is equal to that of the mother cell at the start of meiosis II (23).*

- **What is the difference between anaphase of Meiosis I and that of meiosis II?**
  - During anapahase of meiosis I, there is separation of chr. with 2 chromatids (tetrads).
  - During anapahase of meiosis II, there is separation of sister chromatids of a chromosome.

<u>Activity 4</u> : Fertilization : pp. 144 – 145

The gene which determines the skin pigmentation appears in two versions or alleles:

- « A » **<u>normal</u>** allele capable of controlling the synthesis of melanin.
- « a » **<u>récessive</u>** allele incapable of controlling the synthesis of melanin.



Name: _____ **Class:** Grade 9 **Date:** _____	**Biology Worksheet** Chapter 8

Exercise 1 –

Chromosomal abnormality and meiosis

The diagrams in **document 1** represent only chromosomes 21 and 13 in the somatic (body) cells of two children A and B.

1 – Compare:

- **a**- The number of chromosomes 13 in cells **A** and **B**.
- **b**- The number of chromosomes 21 in cells **A** and **B**.

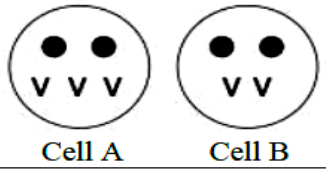
2 - Indicate the child that presents the chromosomal abnormality. Justify the answer.

The diagrams in **document 2** represent the same chromosomes 21 and 13 in some gametes of the parents of the child with this chromosomal abnormality.

3 - Indicate the abnormal parental gamete at the origin of this abnormality. Justify the answer.

4 – Name the phase of meiosis at the origin of this abnormal gamete.

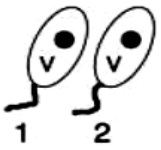
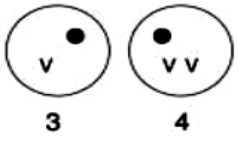
Document 1



Legends :
v : chromosome 13
● : chromosome 21

Document 2

Gametes of the parents

Males	Females
	
1 2	3 4

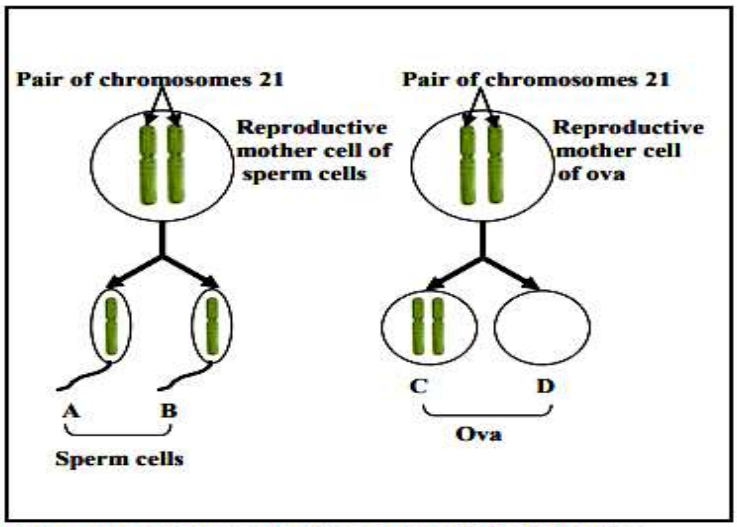
Exercise 2 –

Chromosomal Anomalies

During the formation of gametes, a certain error might occur at the moment of separation of chromosomes in reproductive cells. The adjacent **document** shows the obtained gametes in a male and a female. To simplify the diagram, only a pair of chromosomes 21 is represented.

1- Name the cell division at the origin of the formation gametes.

2- Indicate,by referring to the **document,** the mother cell where an error takes place at the moment of separation of chromosomes 21. Justify the answer.



3- Schematize the chromosomes 21 in the zygote that results from each of the following combinations:

- **a.** Sperm cell **A** with ovum **C**
- **b.** Sperm cell **A** with ovum **D**

4- Name the anomaly observed in each of the obtained zygotes.

Exercise 3 –

Preparatory stage for cell division: Interphase

The opposite **document** shows the variation in the quantity of chromosomal material, as a function of time, in a human skin cell during interphase.

Time (in hours)	**0**	**4**	**6**	**8**	**12**
Quantity of chromosomal material in a cell (in a.u.)	**6.5**	**6.5**	**8**	**13**	**13**

1- Draw a graph showing the variation in the quantity of chromosomal material, in a skin cell, as a function of time.
2- How does the quantity of chromosomal material vary in the human skin cell between the 4^{th} and the 8^{th} hour of interphase?
3- Indicate the number of chromosomes and that of chromatids in the human skin cell at :
   a- t = 4 hrs
   b- t = 12 hrs.

Exercise 4 –

Meiosis

The adjacent **document** shows the behavior of chromosomes during the first meiotic division in humans.
For simplification, only three pairs of chromosomes are presented.
1- Identify the phase of meiosis presented in:
- figure a
- figure b

2- Determine the sex of the individual which is at the origin of this cell.
3-Indicate:
a. the number of cells obtained at the end of meiosis.
b. the number of chromosomes in each of the obtained cells at the end of meiosis.
4-Justify this statement: "Meiosis is a reductional division".

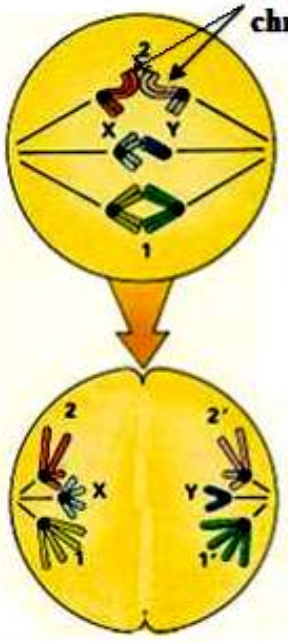


Figure a
Arrangement of homologous chromosomes in the middle of the cell

Figure b
Migration of the chromosomes, each of two chromatids, towards the extremities of the cell