This chapter includes the following:

(Referring to the National textbook)

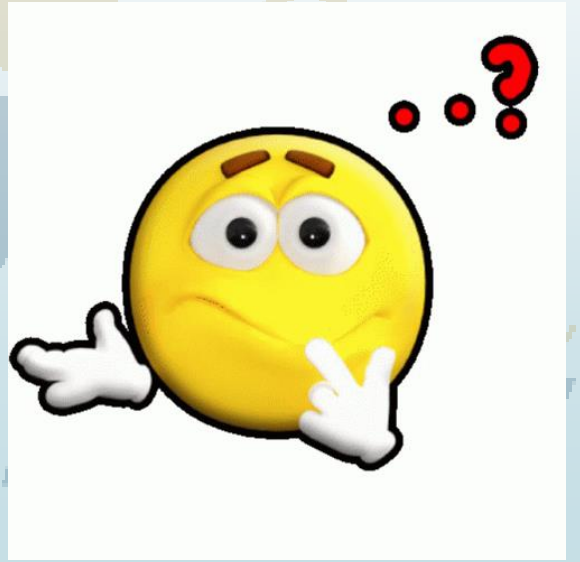
- Document 1: Male and Female Reproductive Systems
- Document 2: Diploid and Haploid Cells
- Document 3: Meiosis
- Document 4: Spermatogenesis
- Document 5: Oogenesis
- Document 6: Fertilization

Document 3:

Meiosis

- All diploid body cells contain 2n chromosomes, except sex cells which contain n chromosomes.

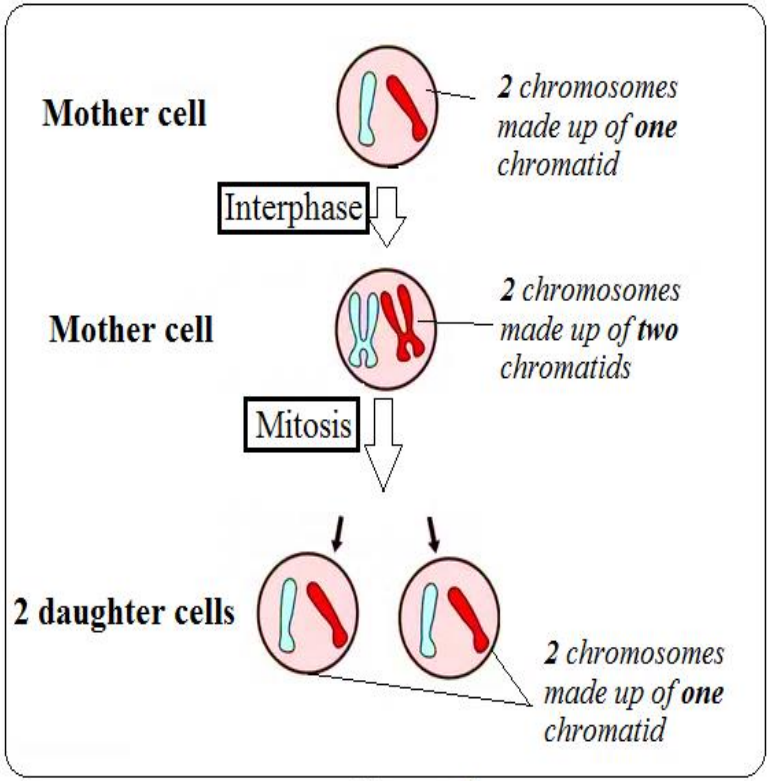
*How is a diploid cell transformed into a haploid cell?



Before talking about meiosis let's talk remember mitosis.

Video Time

- **Mitosis:** is a cell division by which somatic cells and germ cells divide to produce two daughter cells.
- The obtained daughter cells are identical to each other and to the mother cell.
- Mitosis is a "Conformed Reproduction" = genetic material is transmitted from the mother cell to the two daughter cells with no gain or loss / Genetic information is conserved.



Document 1

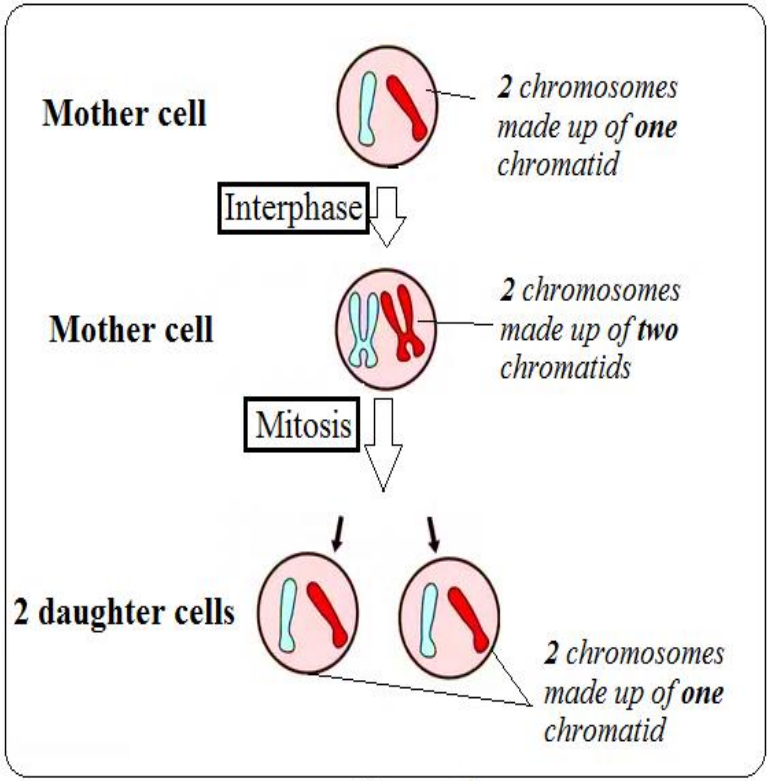
* Aim of Mitosis:

- Growth and development.
- Replacement of dead, old or injured cell.
- Conservation of genetic material from the mother cell to the daughter cells.

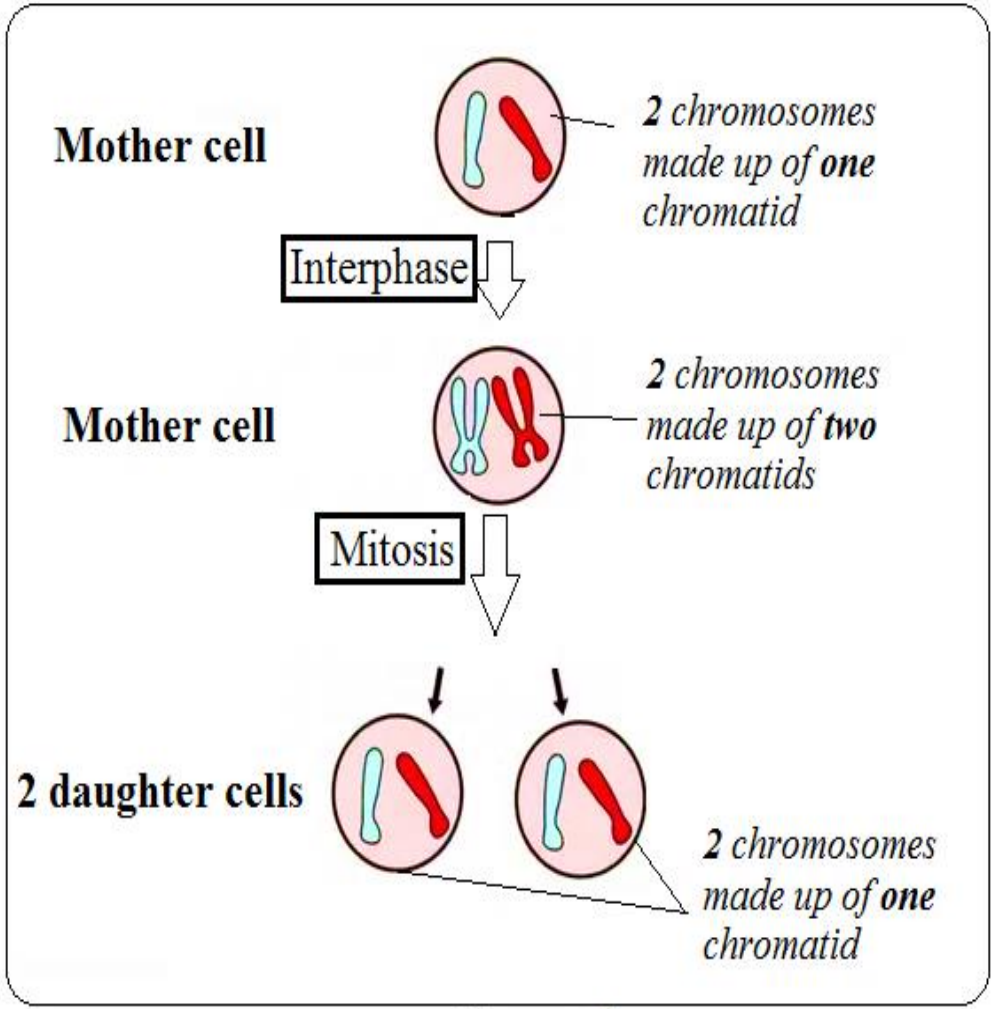
- Mitosis is preceded by a phase called interphase during which the cell prepares itself for division.
- Interphase + Mitosis = Cell cycle.
- Document 1 shows a schematic diagram of a cell undergoing mitosis.

(Q : is the quantity of genetic material)

- Interphase has 3 subphases : G1-S-G2
- The quantity of genetic material duplicates during S phase of interphase (Q → 2Q) .



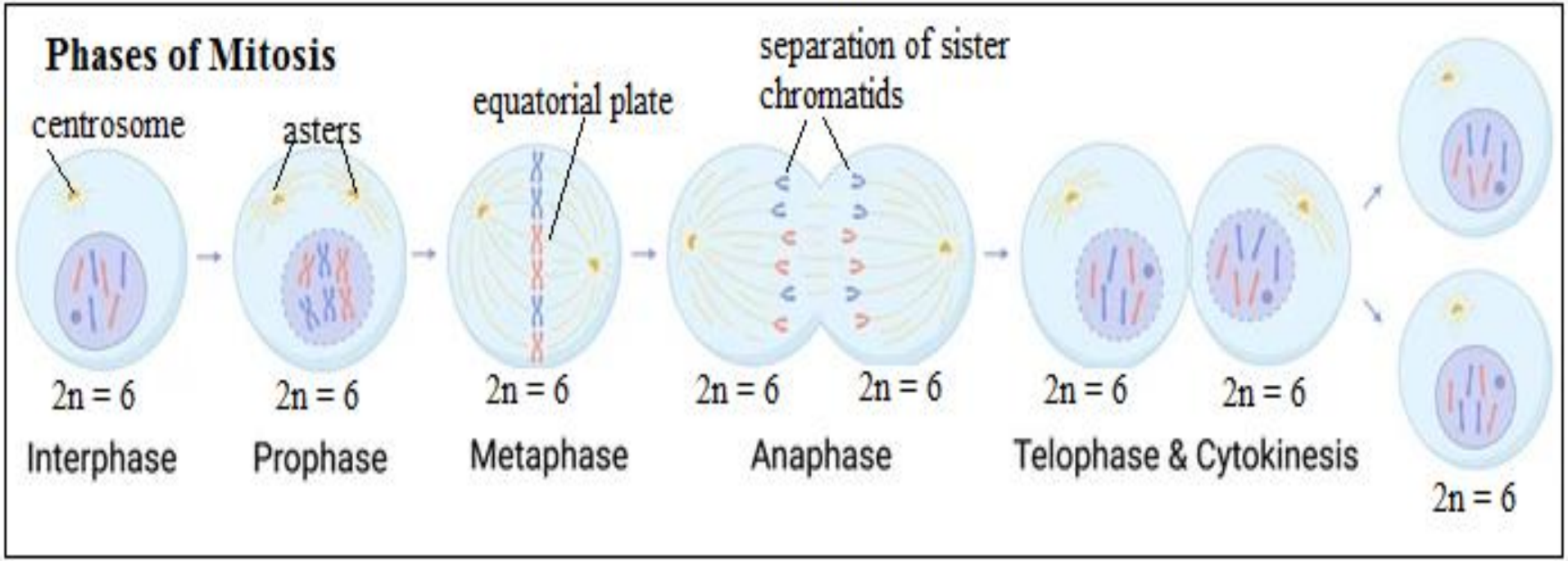
Document 1


Mother cell
2 chromosomes made up of one chromatid
Interphase
Mother cell
2 chromosomes made up of two chromatids
Mitosis
2 daughter cells
2 chromosomes made up of one chromatid

Document 1

- **Mitosis has 4 phases: (Doc.2)**

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



Doc.2

- **Genetic material (DNA) may be in the form of:**

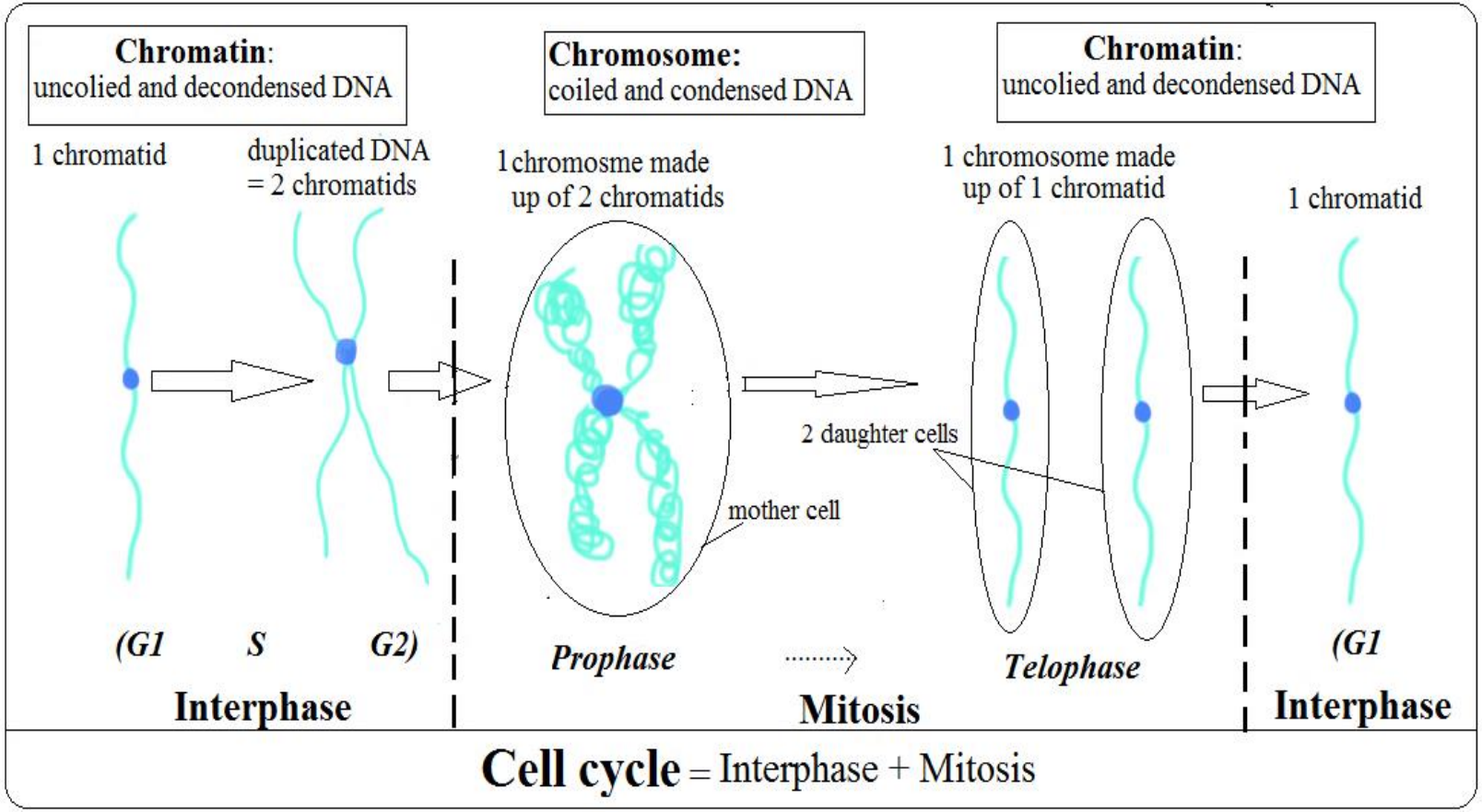
  1- Chromatin fibers.

  2- Chromosome .

- Behavior of Chromosomes During a Cell Cycle: (Doc.3)

  -DNA condenses during mitosis into chromosomes (coiled) and decondenses during interphase into chromatin .

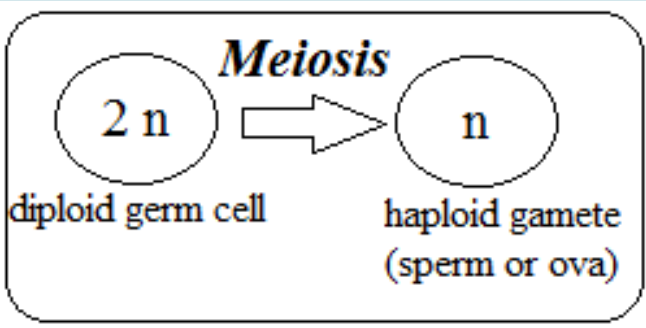
➢ Behavior of Chromosomes During a Cell Cycle: (Doc.3)



Doc.3

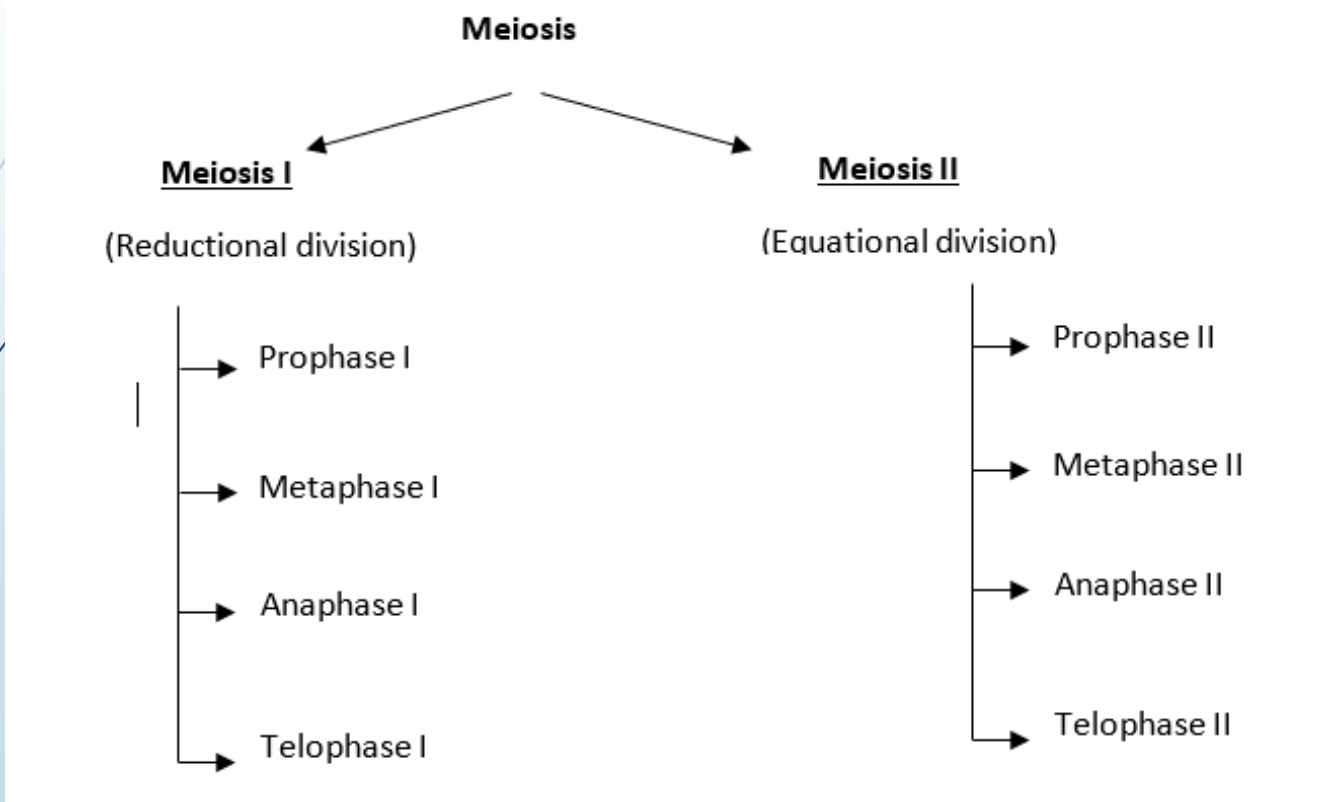
➢ Meiosis:

- **Definition:** is a cell division during which a diploid germ cell divides to produce haploid gametes (sex cells: sperms or oocytes).
- **Aim:** Production of haploid sex cells or gametes (oocytes in females and sperms in males).
- **Location/site of meiosis:** It takes place in the genital organs:
  - ☞ Testes or testicles in males to produce sperms
  - ☞ Ovaries in females to produce oocytes



- **Meiosis has two divisions:**

-Meiosis I and Meiosis II, each division has 4 phases.



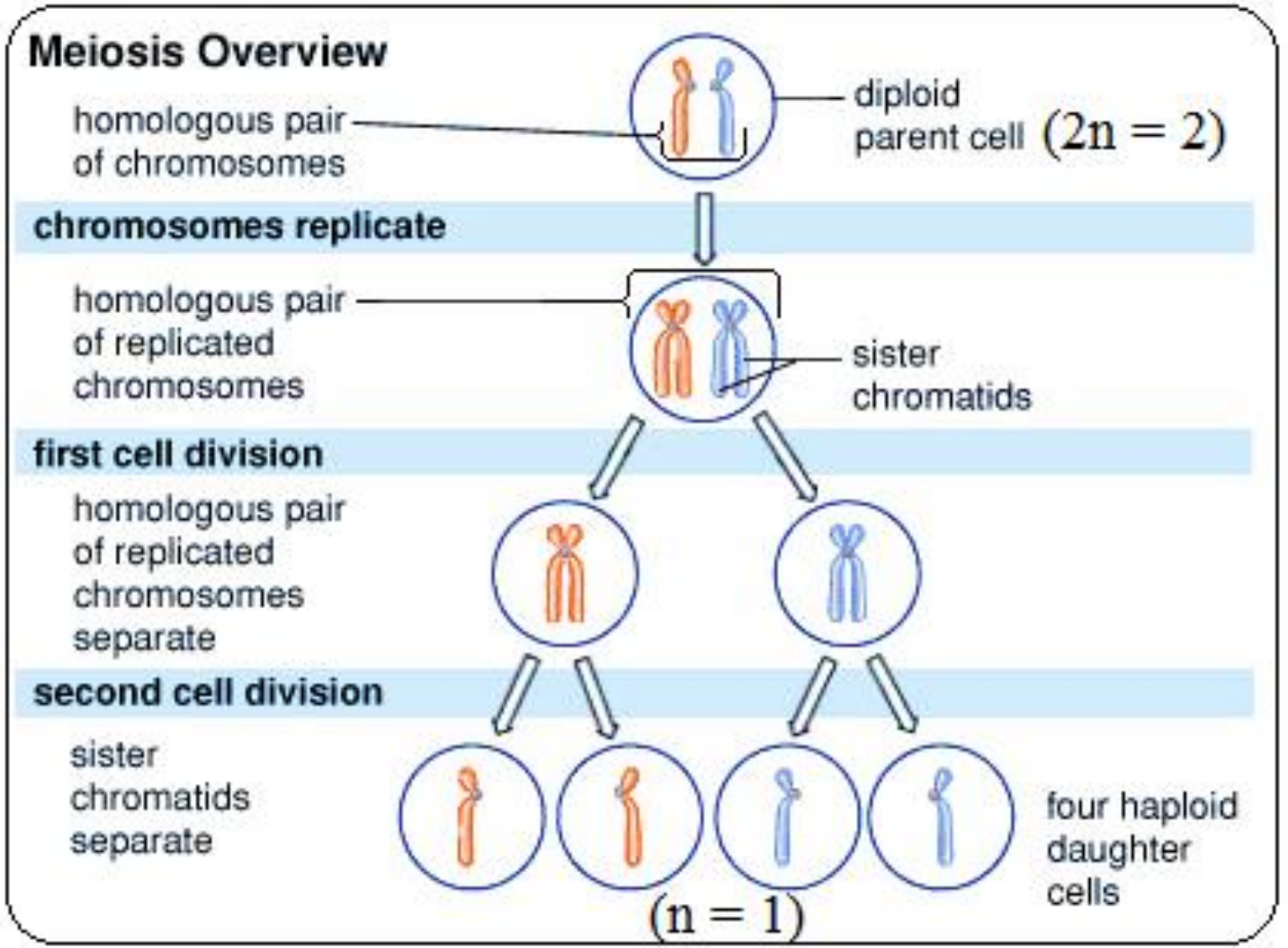
- Meiosis is preceded by interphase.
- Meiosis includes 2 successive divisions of a diploid (2n) cell to produce 4 haploid daughter cells (n).

- Main event occurring in Meiosis 1:

  Separation of homologous pairs of chromosomes.

- Main event occurring in Meiosis 2:

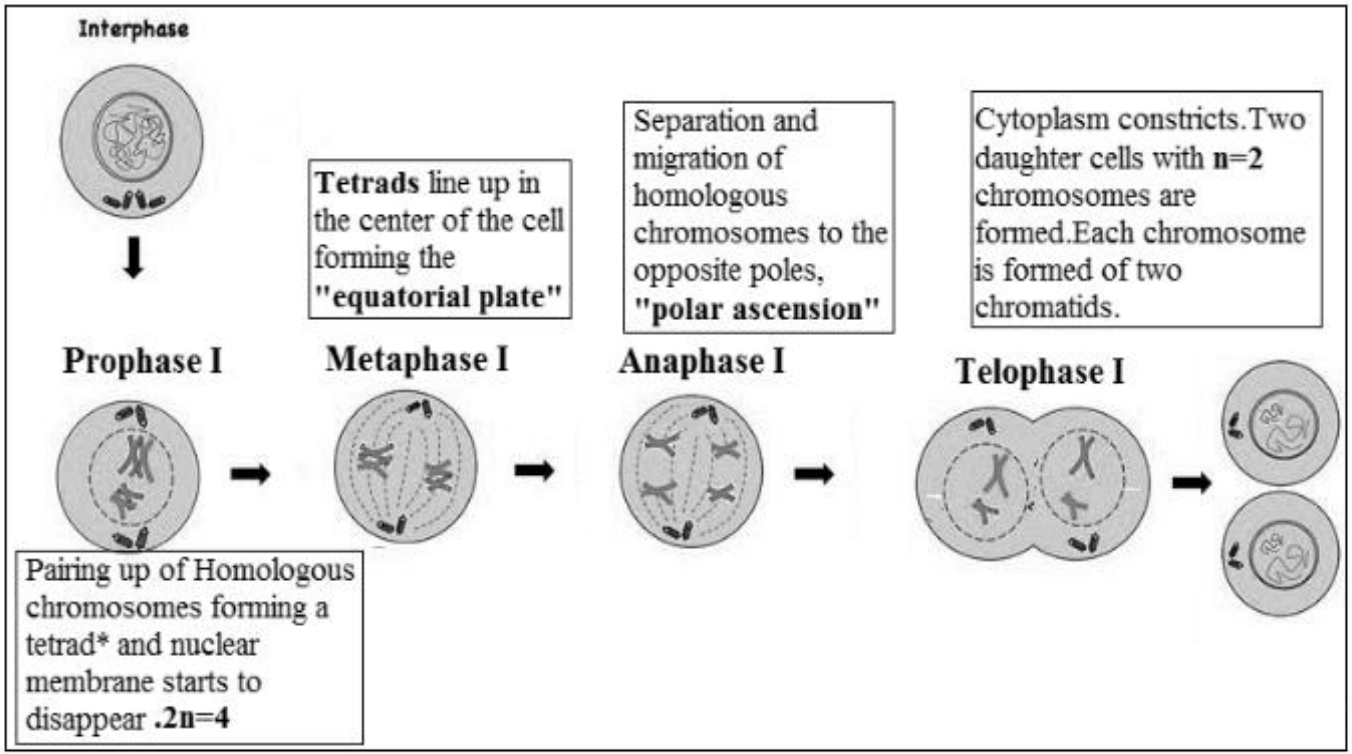
  Separation of sister chromatids.


Meiosis Overview
homologous pair of chromosomes
diploid parent cell (2n = 2)
chromosomes replicate
homologous pair of replicated chromosomes
sister chromatids
first cell division
homologous pair of replicated chromosomes separate
second cell division
sister chromatids separate
four haploid daughter cells
(n = 1)

- Document 2 shows the main steps occurring in the first meiotic division, Meiosis I.

☞During meiosis I, the number of chromosomes is reduced to half:

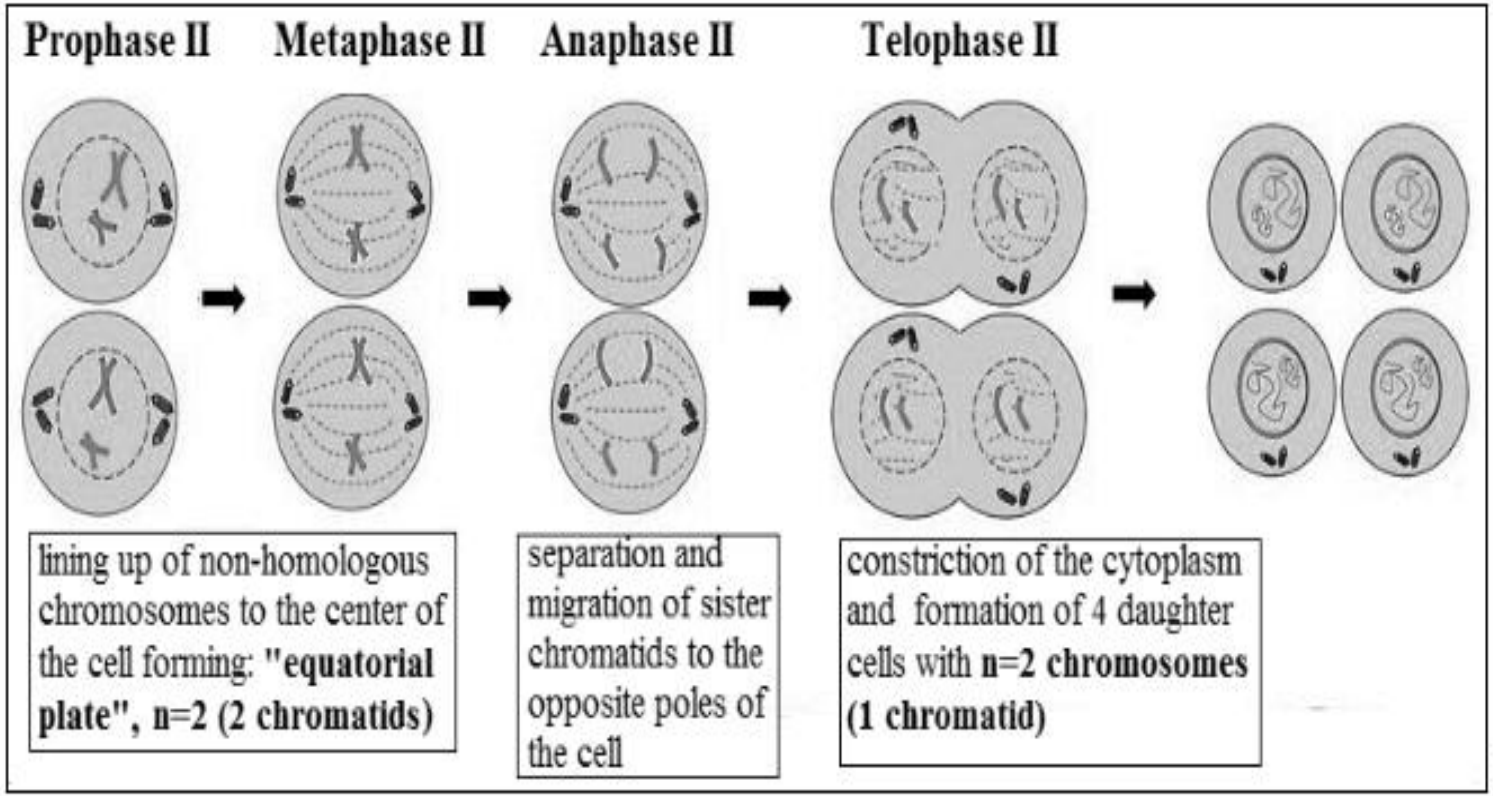
2n → n , 46 → 23 or 4→2(reductional division) .



Document 2

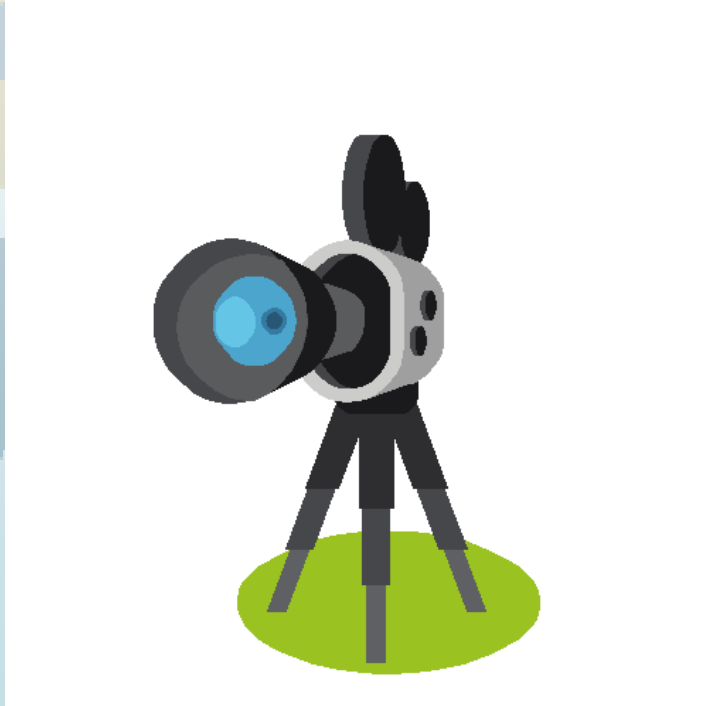
*Document 3 shows the main steps occurring in the second meiotic division, Meiosis II.

Meiosis II



Document 3

Video Time



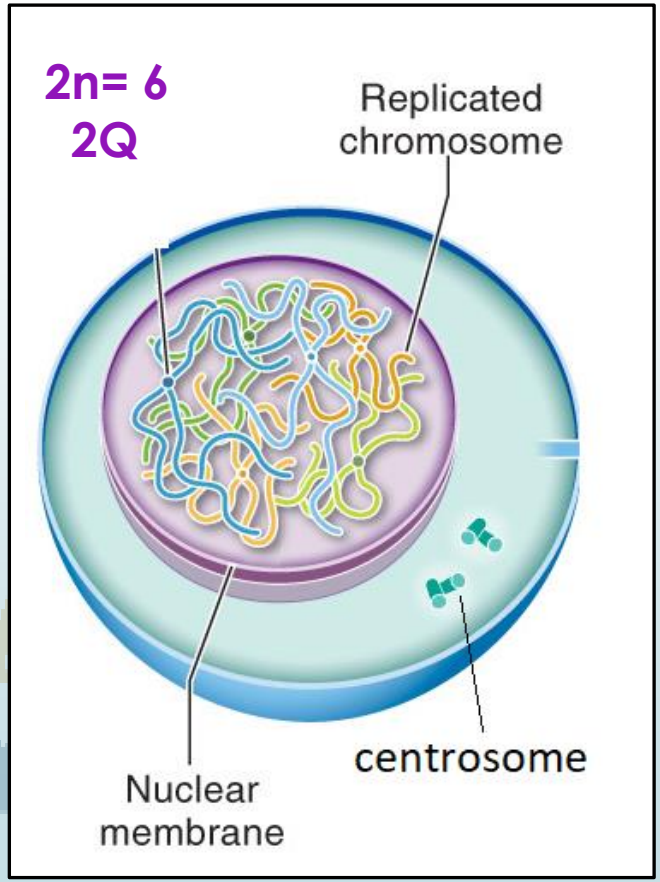
-Application 1:

Given an animal germ cell having 6 chromosomes during different phases of the cell cycle.

Indicate the number of chromosomes n, and the quantity of genetic material Q.

The steps are written.

- Interphase:



I. Meiosis I (reductional division) : P I, M I, A I, T I.

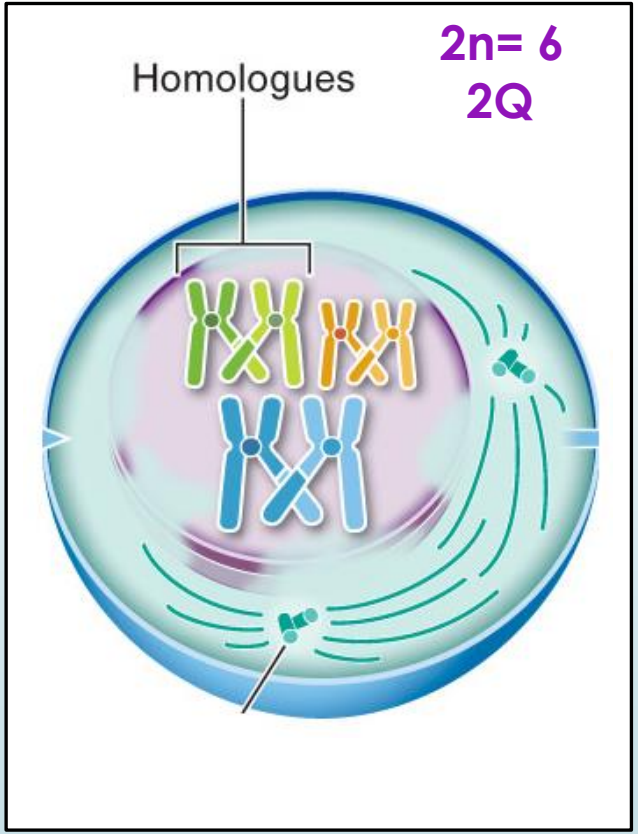
- **Prophase 1:**

-Long thin chromatin condenses into chromosomes (made of 2 chromatids and joined by a centromere).

-nuclear membrane starts to disappear.

- centrosome changes into asters, where spindle fibers are formed between them.

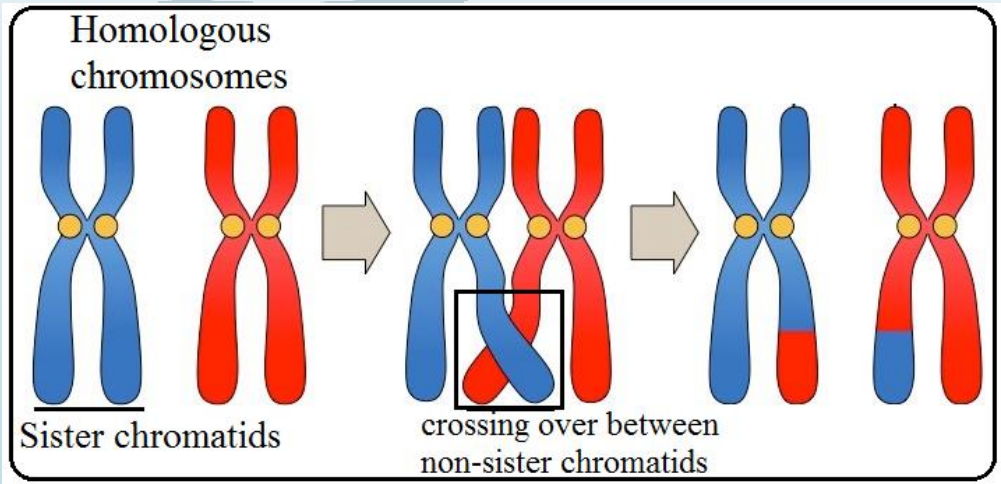
- homologous chromosomes pair up together forming a tetrad (4 chromatids).
- **crossing over** occurs between the homologous pairs of chromosomes.



☞Crossing over:

Is the exchange of a part or segment of genetic information between non-sister chromatids of a homologous pair of chromosomes. It occurs during prophase 1 of Meiosis 1.

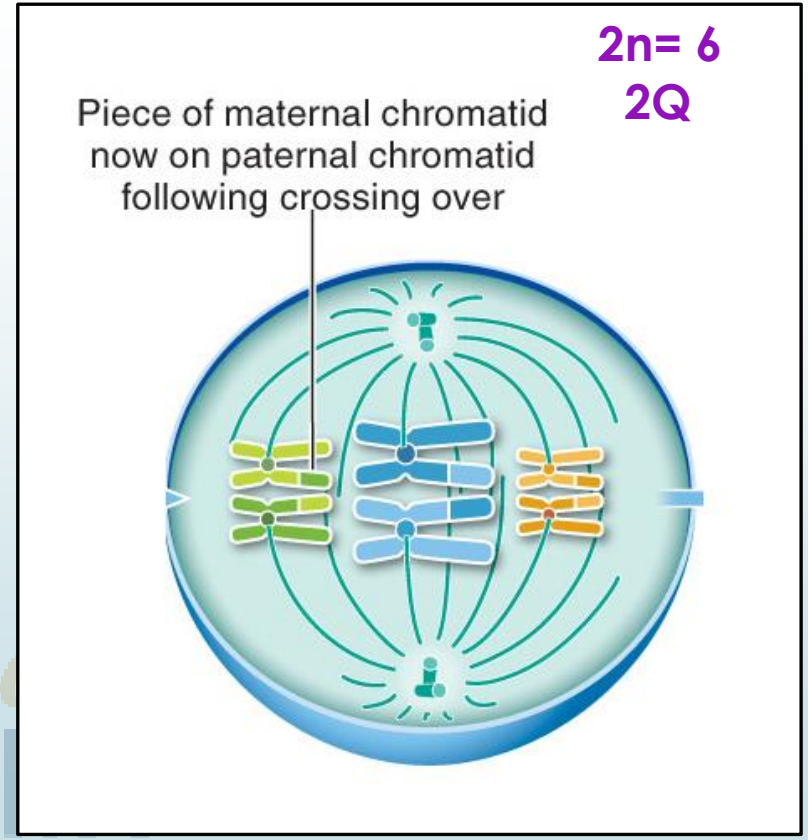
☞Crossing over leads to genetic diversity in the produced gametes.



Be Smart ACADEMY

- Metaphase I:

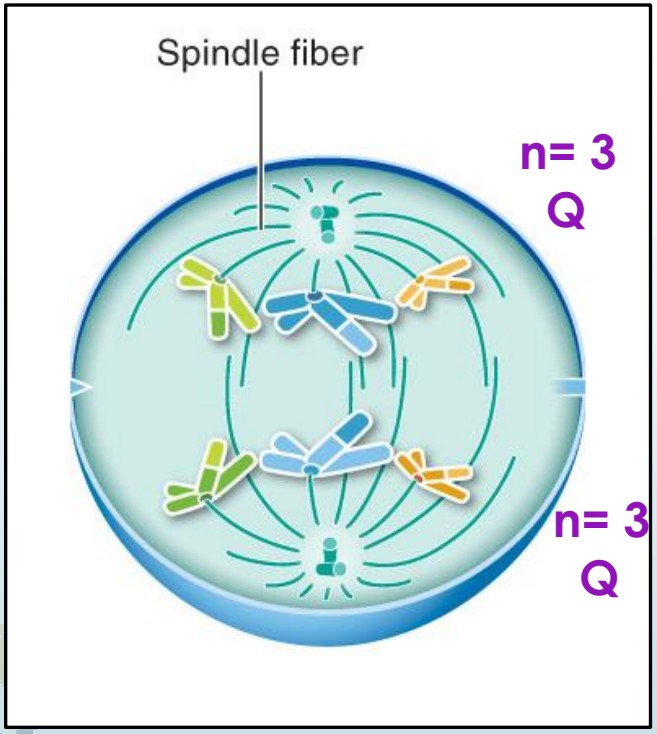
-Homologous chromosomes, or **tetrads** arrange themselves at the equator (center) of the cell forming the equatorial plate.



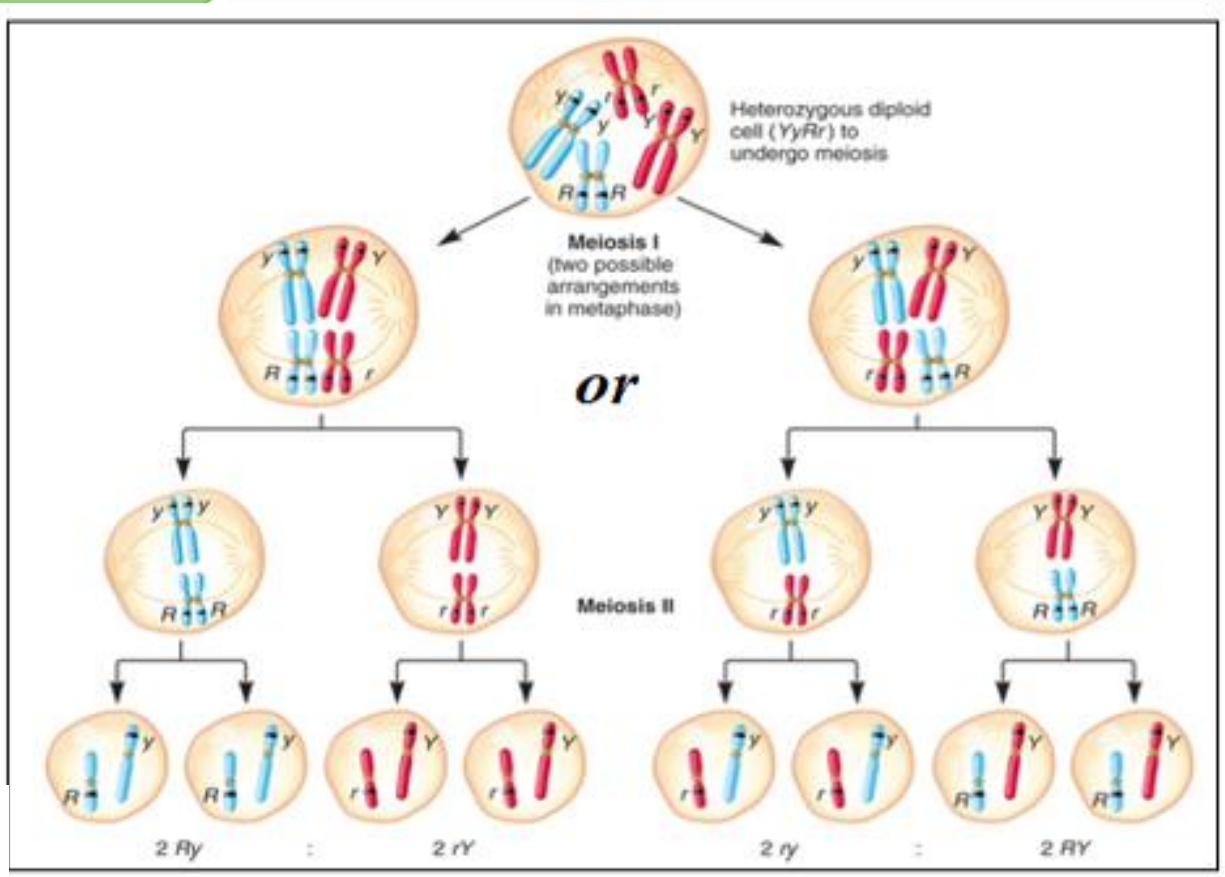
- Anaphase I:

-Homologous chromosomes separate to the opposite poles of the cell.

-Each chromosome is made up of 2 chromatids.

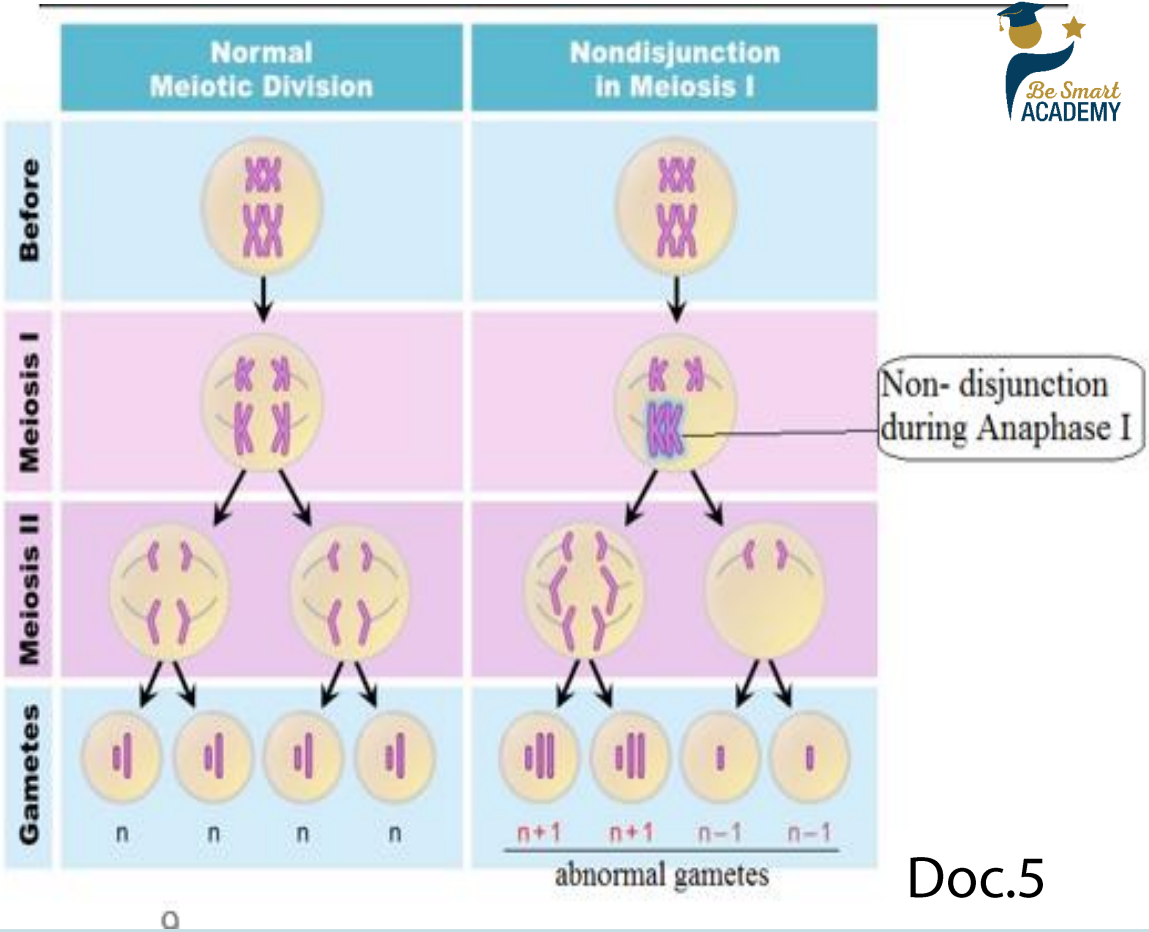


☞ ***The random separation of homologous chromosomes during anaphase I, is a second cause of genetic diversity in the produced gametes.***Doc.4



Doc.4

☞ *An error in the separation of homologous pair of chromosomes (non-disjunction) during anaphase I, may lead to the production of abnormal gametes having excess (n+1) or deficiency (n-1) in the genetic information.*Doc.5



Doc.5

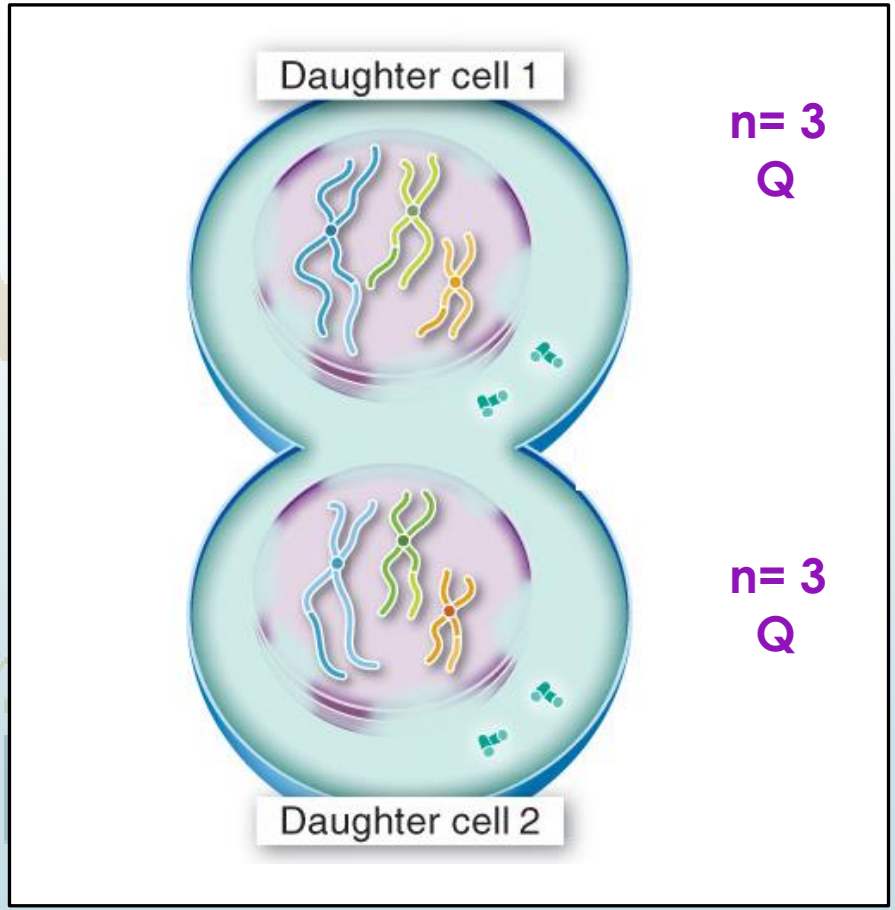
- Telophase I:

-The chromosomes decondense into chromatin fibers.

-Asters change back into centrosome and the spindle fibers disappear.

-The nuclear membrane reappears.

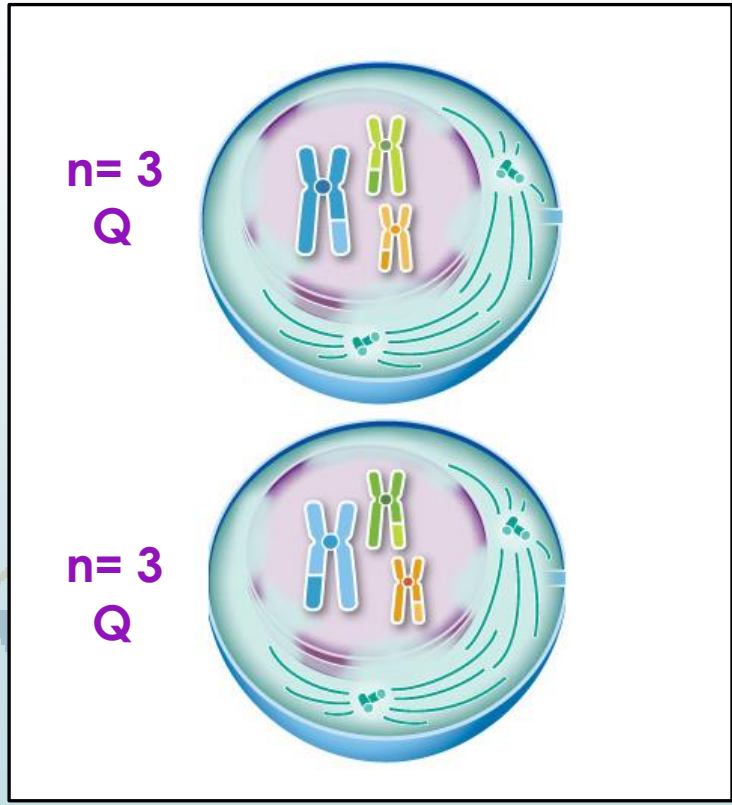
-A constriction is formed in the cytoplasm that divides the mother cell into 2 daughter cells each daughter cell has n chromosomes,each chromosome is made up of 2 chromatids.



II. Meiosis II (equational division) : P II, M II, A II, T II

- **Prophase II:**

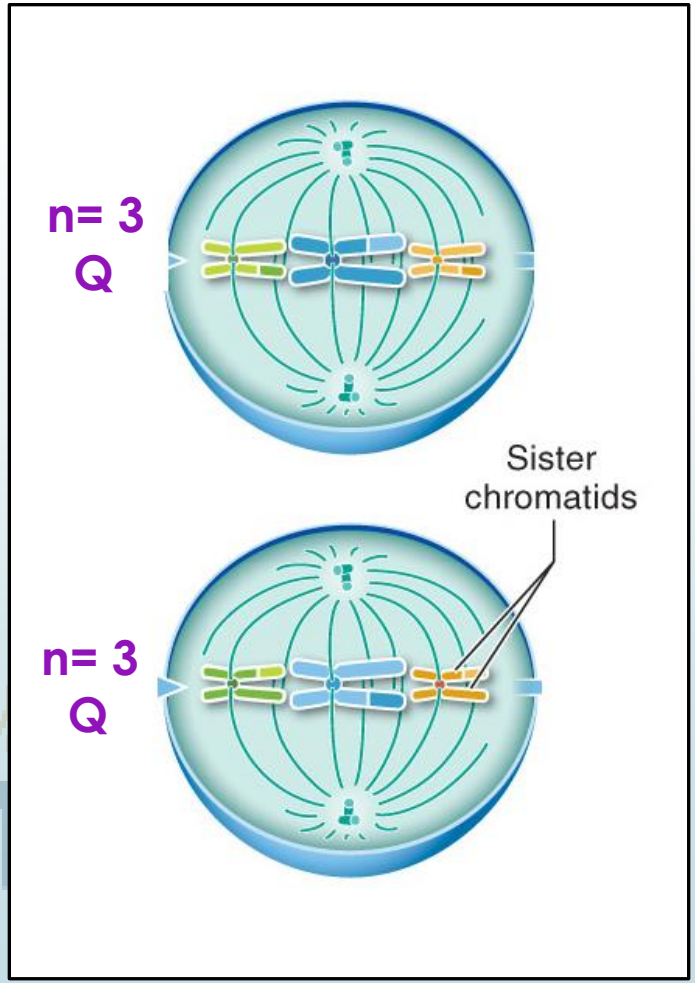
-Long thin chromatin condenses into chromosomes (made of 2 chromatids and joined by a centromere).
-nuclear membrane starts to disappear.
-centrosome changes into asters, where spindle fibers are formed between them.



- Metaphase II:

-Non-homologous chromosomes arrange themselves at the center of the cell forming the equatorial plate.

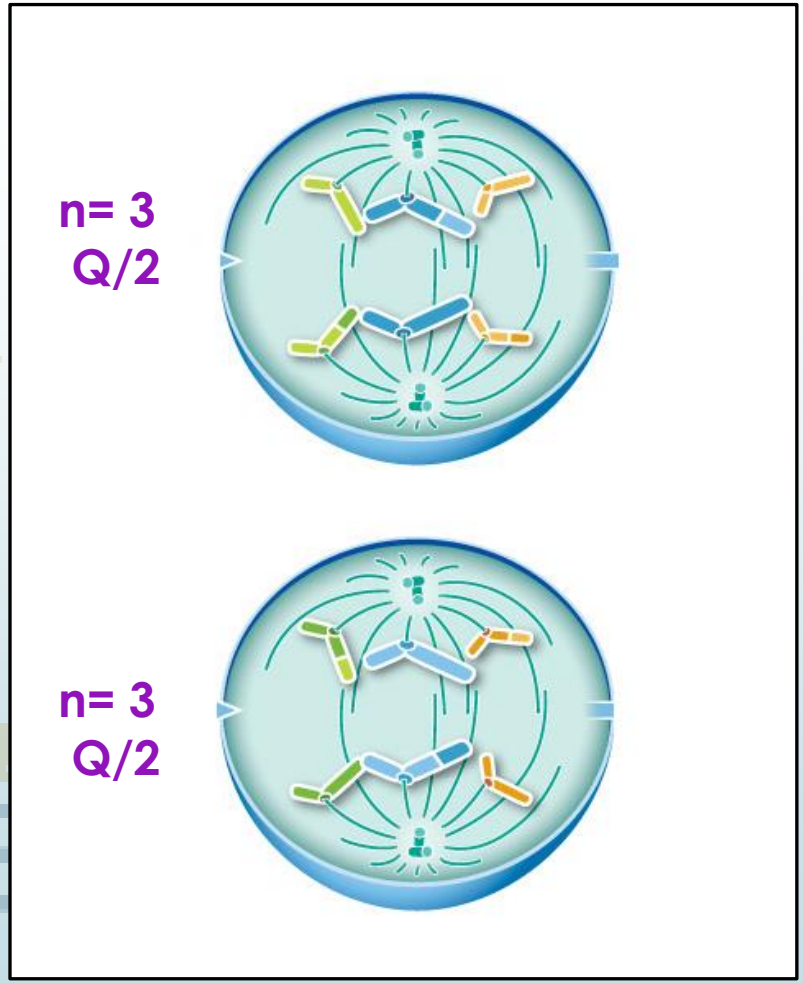
-Each chromosome is made up of 2 chromatids.



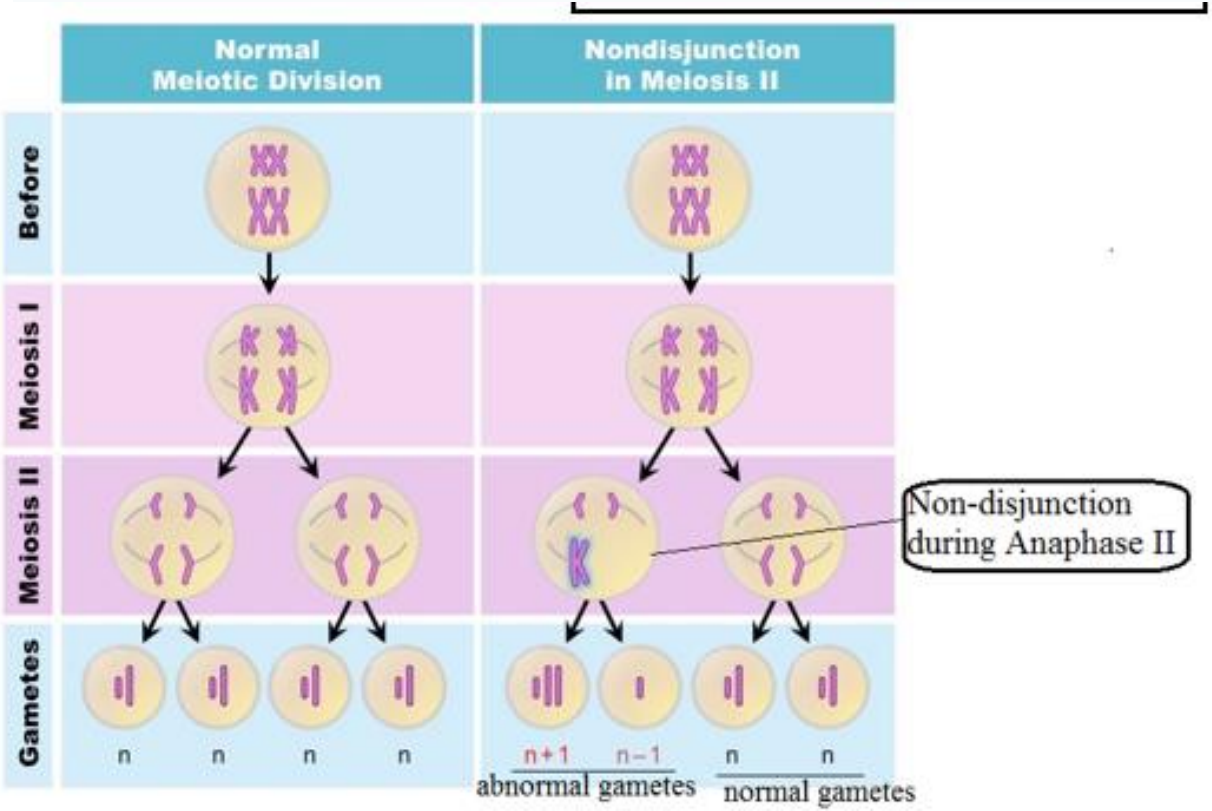
- Anaphase II:

-The centromere divides and the **sister chromatid separate** to the opposite poles of the cell.

-Each chromosome is made of 1 chromatid.



☞An error in separation of sister chromatids during anaphase 2, may lead to the production of abnormal gametes. Doc.6



- **Telophase II:**

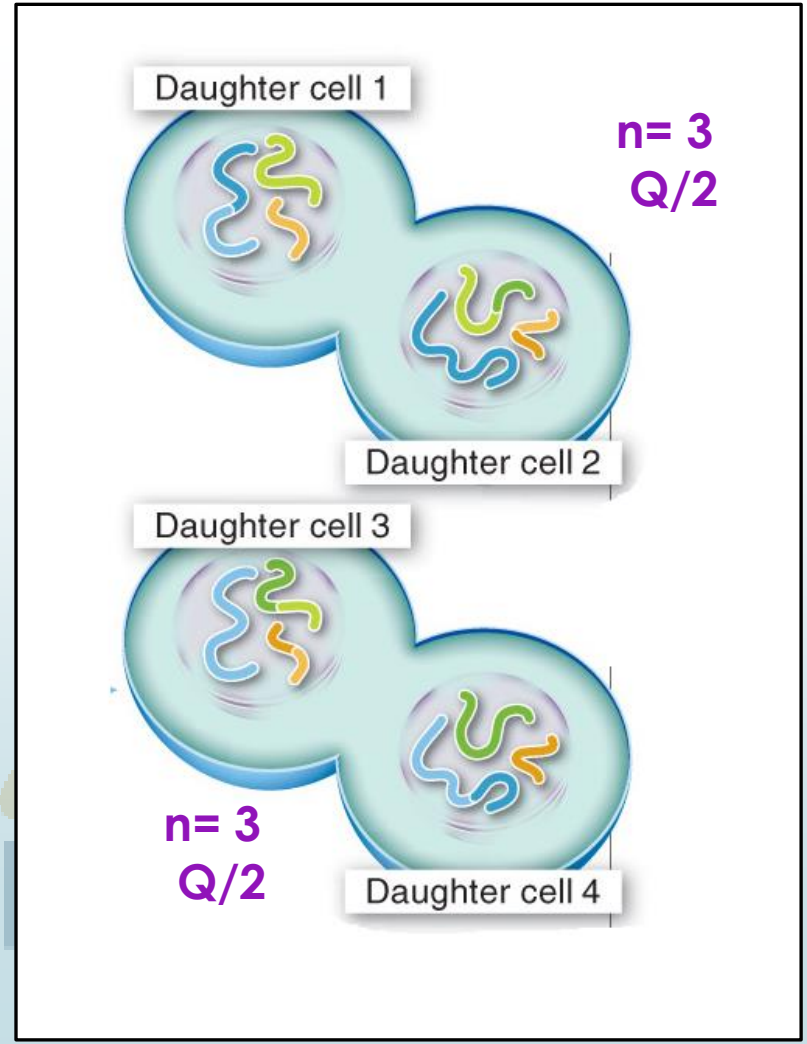
-The chromosomes decondense into chromatin fibers.

-Asters change back into centrosome and the spindle fibers disappear.

-The nuclear membrane reappears.

-A constriction is formed in the cytoplasm of each of the 2 daughter cells.

-production of 4 genetically different haploid cells.



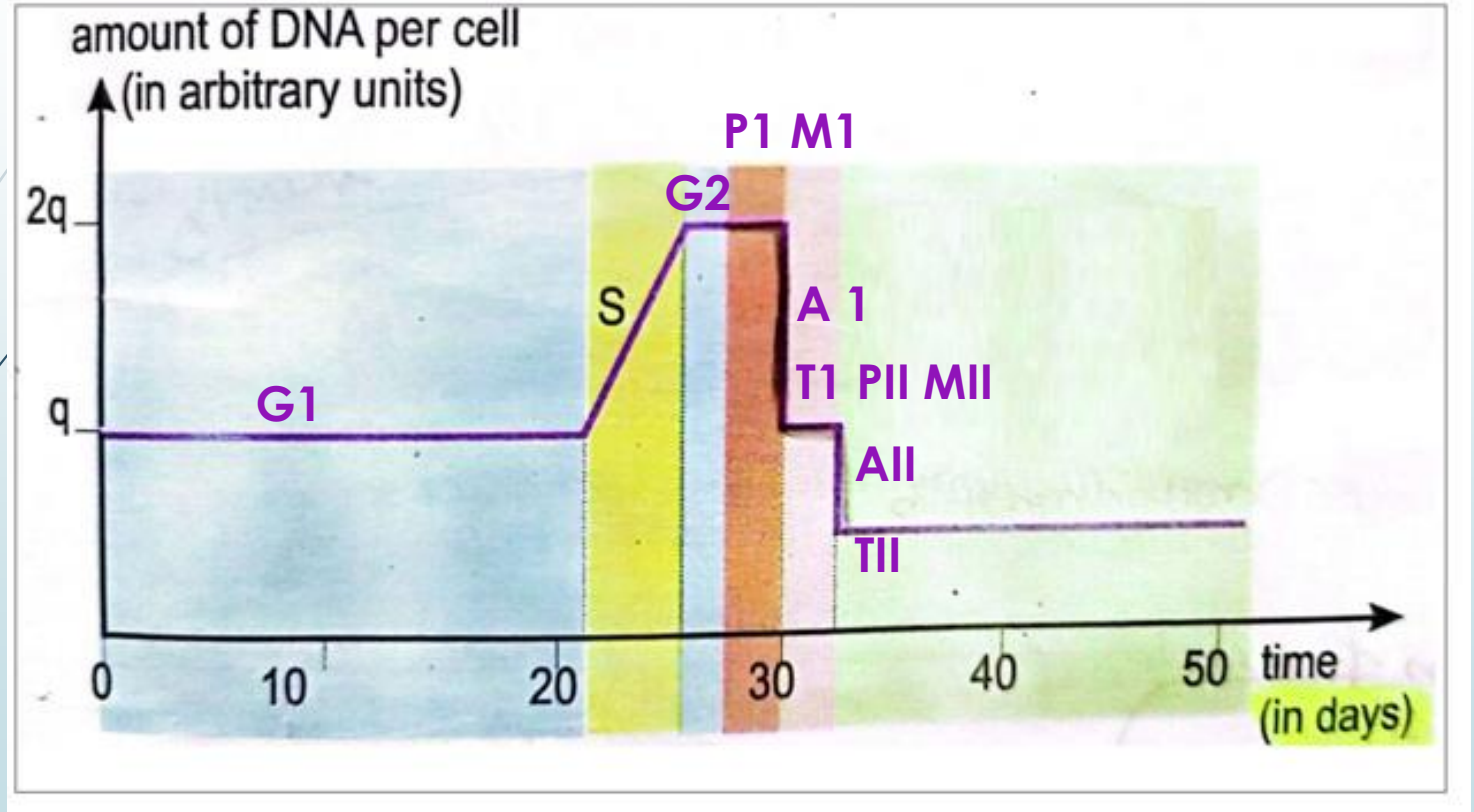
- Number of different gametes = 2^n

n: number of pairs in a human mother cell, number of pairs is (46/2= 23)

⇒ $2^{23} = 8388608$ different gametes Wooooooooow!

- **Application 2:**

Locate on the graph below the different phases of interphase and meiosis.



Nb 3 and 5.

Probing the documents

1. Referring to ***doc.b***, name the different steps of meiosis represented in ***doc.a***, and arrange them according to their chronological order.
2. Indicate, on the graph of ***doc.c***, the following steps: interphase, 1st meiotic division, 2nd meiotic division, anaphase I and anaphase II.
3. Is there any DNA replication during meiosis? During which phase of the cell cycle does DNA replication take place?
4. Referring to what you have learned in the second year of the secondary education, sciences section, construct a comparative table of mitosis and meiosis.
5. What will happen if meiosis does not take place?

3- No , there is no DNA replication during meiosis. DNA replication takes place during S-phase of interphase which precedes meiosis.

5- If there is no meiosis, there will be no production of sex cells/gametes and no production of new generation.