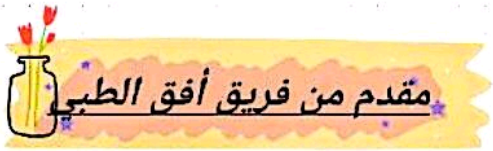
مقدم من فريق أفق الطبي


جامعة الأزهر - غزة
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حركة الشبيبة الفتحاوية
جامعة الأزهر
Fateh Youth Movement

Cell cycle& division

Dr.ImanNabil


Why?
tell me
why!

The cell cycle

- Definition: it is the alternation between interphase and mitosis.

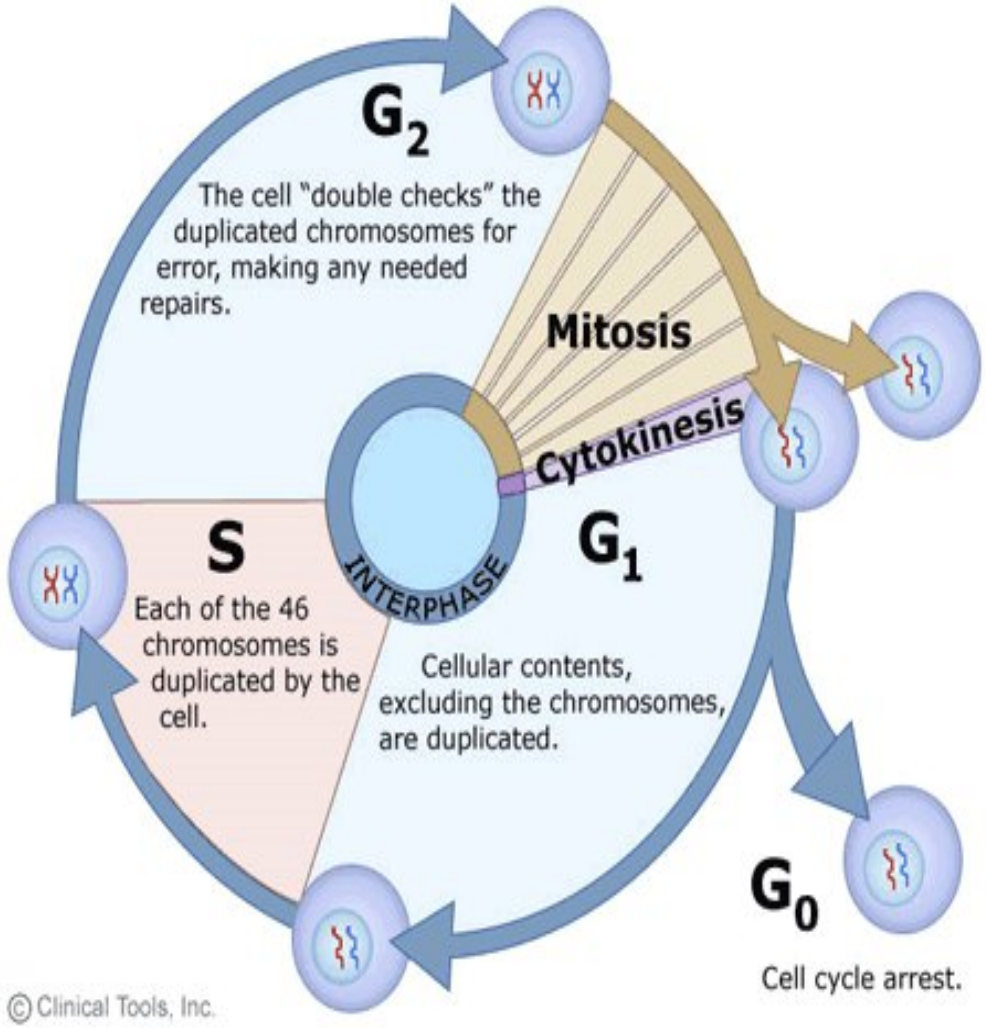
I-Interphase a longer period:

1- The cell increases in size.

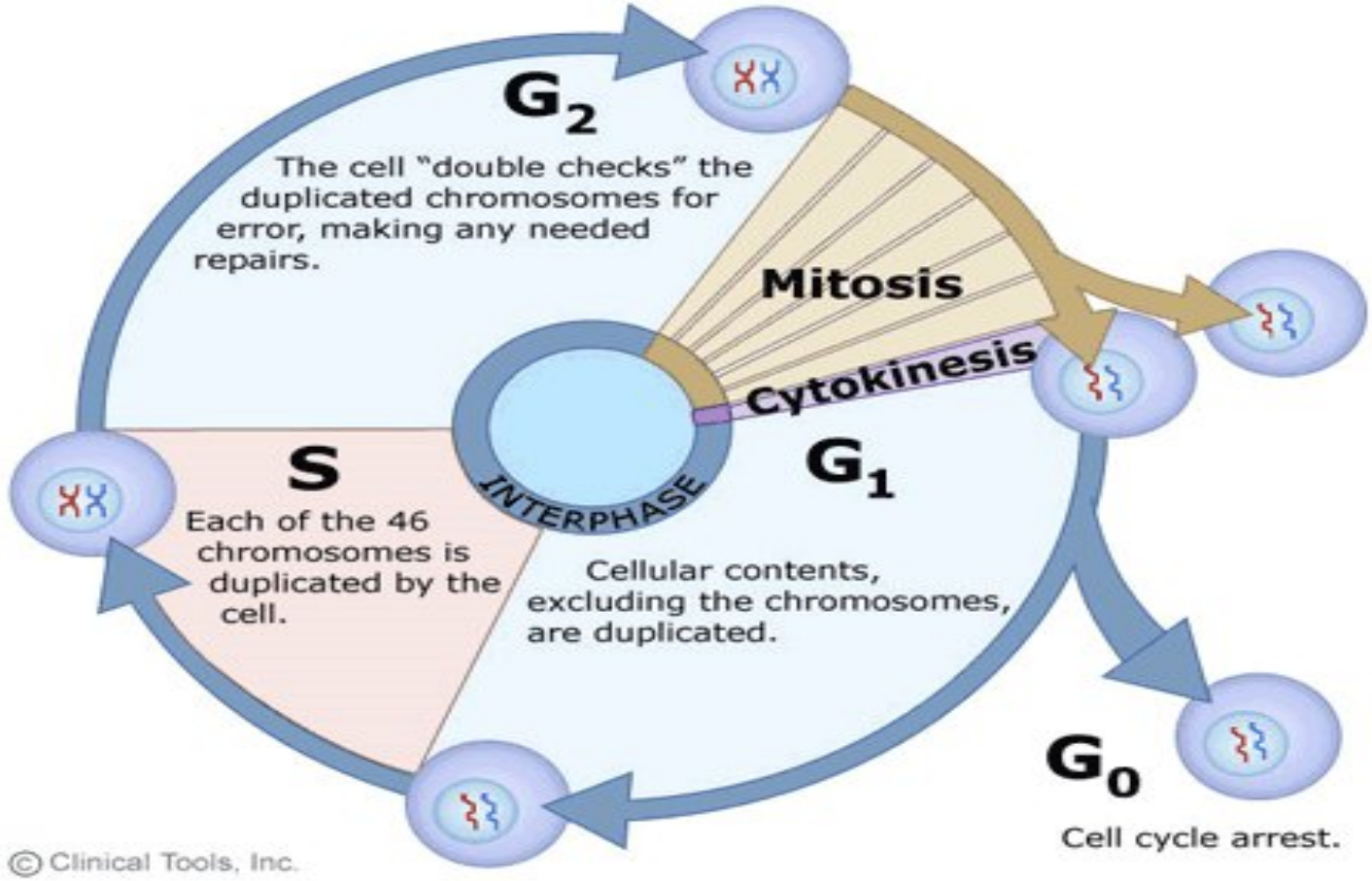
2- Performs its normal functions.

3- Replicates its DNA for preparing itself for division.

II-Mitosis: a shorter period during which parent cell gives 2 daughter cells each containing the same number of chromosomes (identical to the parent cell=46 chromosomes).



I-Interphase



First gap phase (G phase)

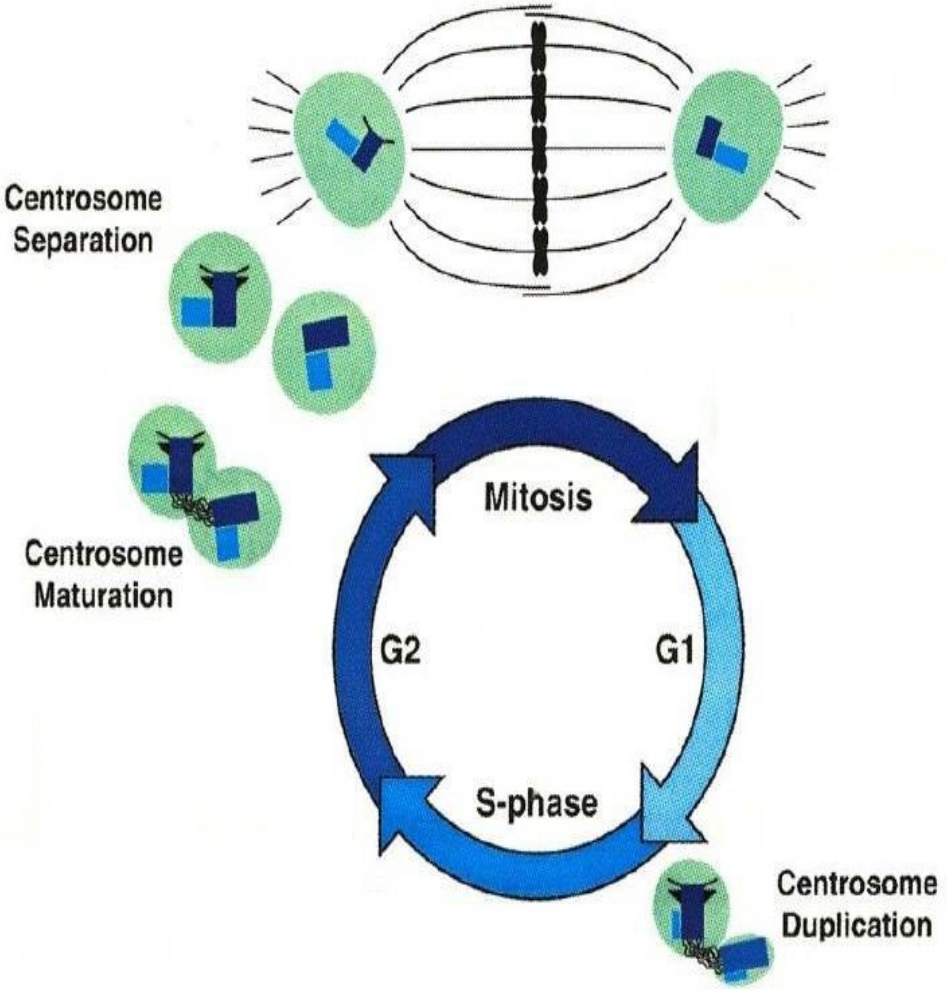
- It is *the longest period* of the cell cycle between the end of mitosis and the beginning of DNA replication:

1- The RNA and protein synthesis occurs.

2- The cell attains its full size.

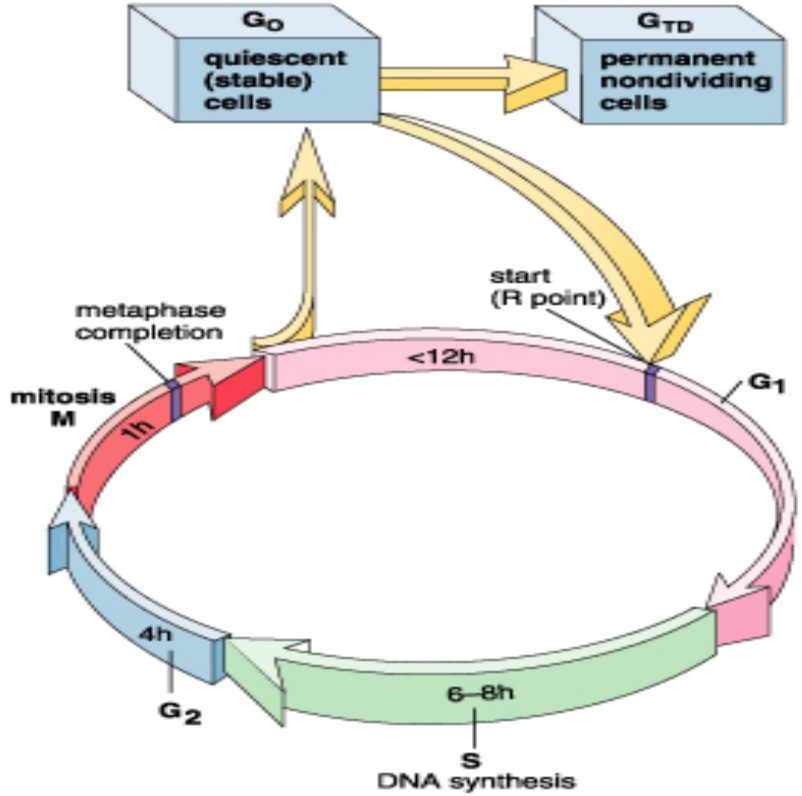
3- The cell performs its function.

4-Duplication of centrosomes occurs near the transition between G_1 and S phase.



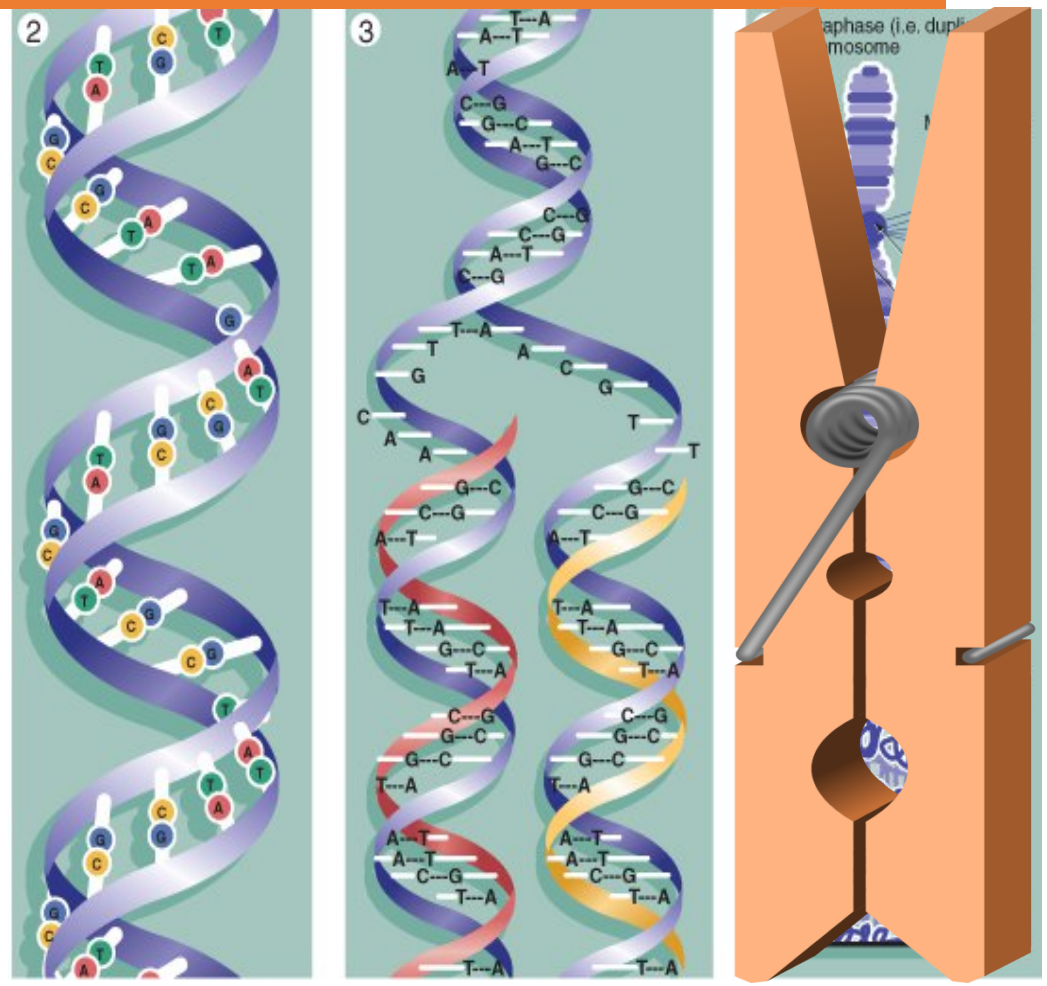
The GO phase

- **Definition**: Differentiation of the cell to carry out specialized function and no longer divide(*outside the cycle*).
- GO may be *permanent* or *temporary*.



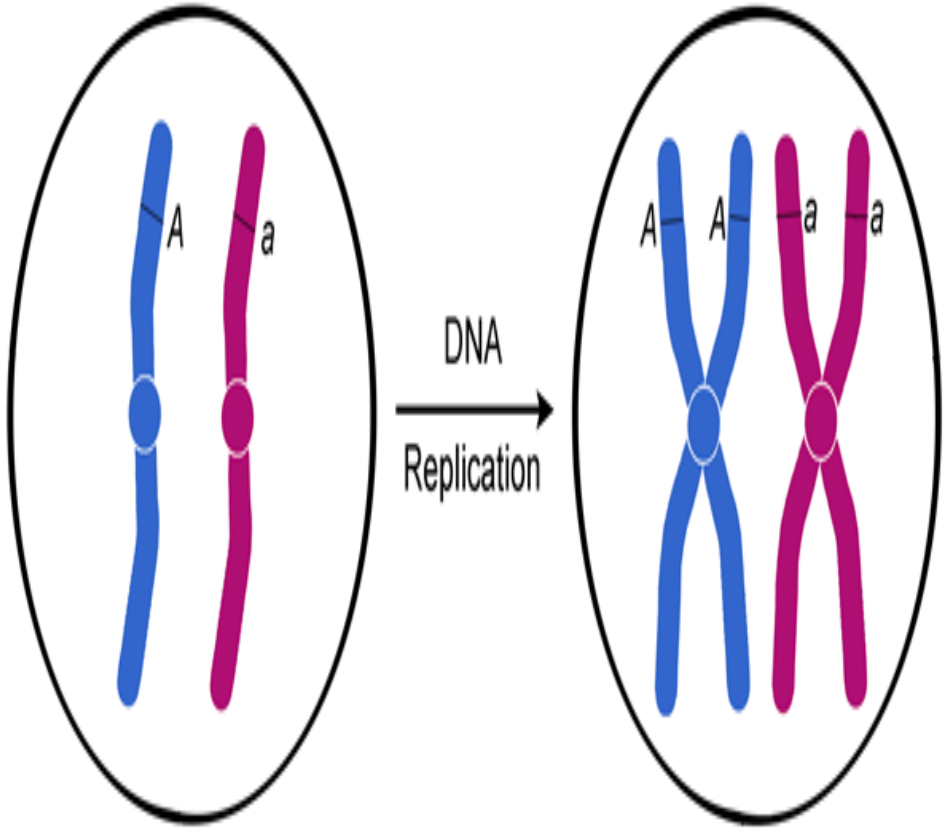
DNA synthesis phase (S phase)

- Replication of DNA, thus the amount of DNA is doubled but *not the total chromosomal number*.

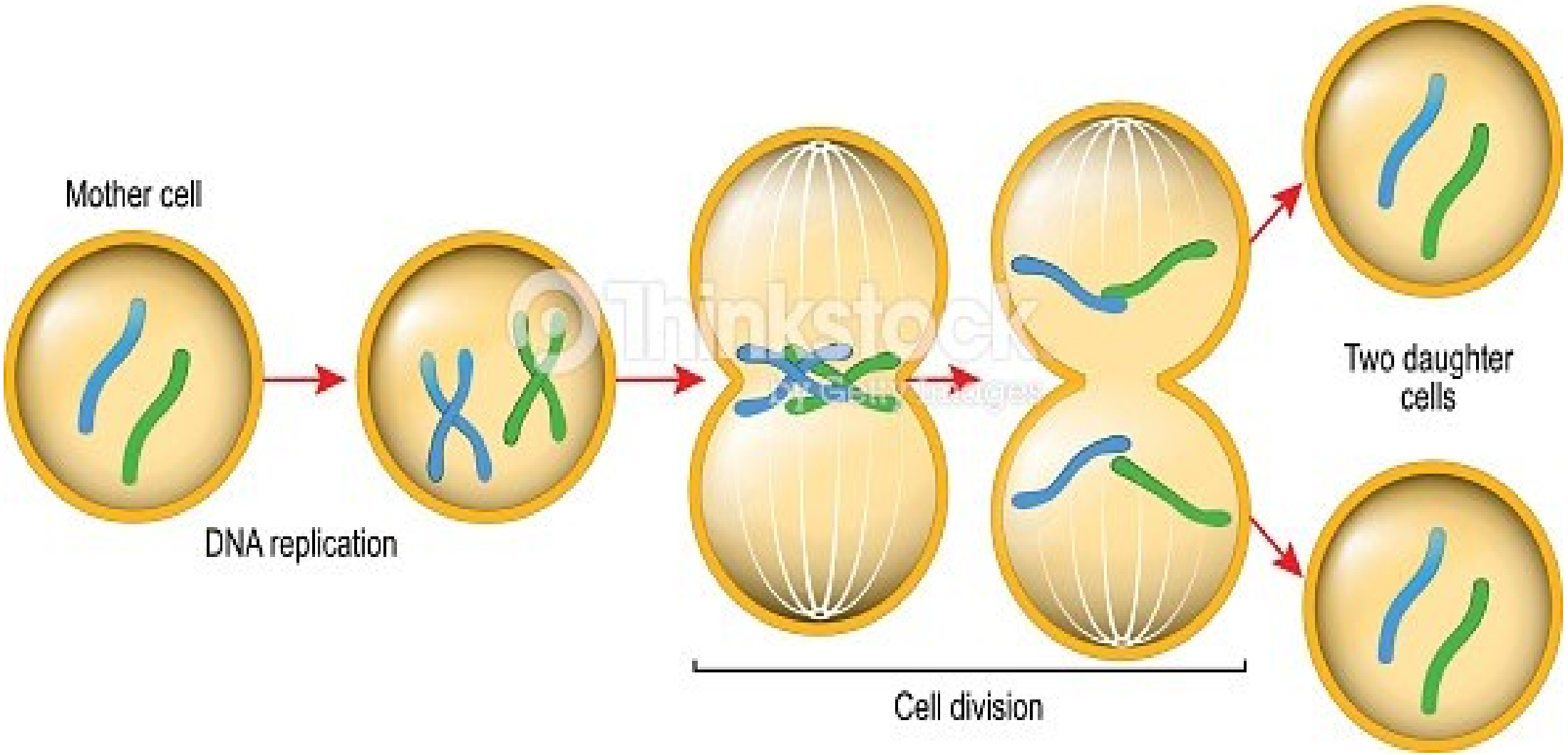


Types of chromosomes

- **s-chromosomes:** made of one DNA molecule (interphase chromosomes = chromatin or chromatids).
- **d-chromosomes** (mitotic chromosomes): are formed during the S phase. Each d-chromosome is formed of two chromatids, linked at the centromere. Each chromatid is made of a DNA molecule.



MITOSIS

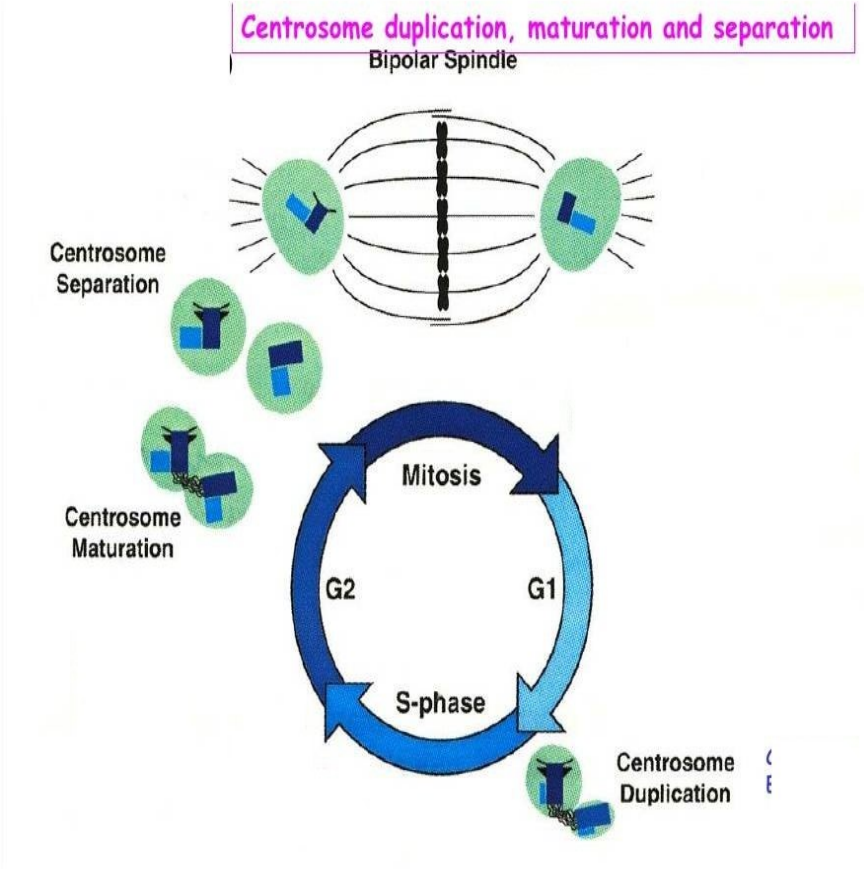

Mother cell
DNA replication
Two daughter cells
Cell division

Second gap phase (G2 phase)

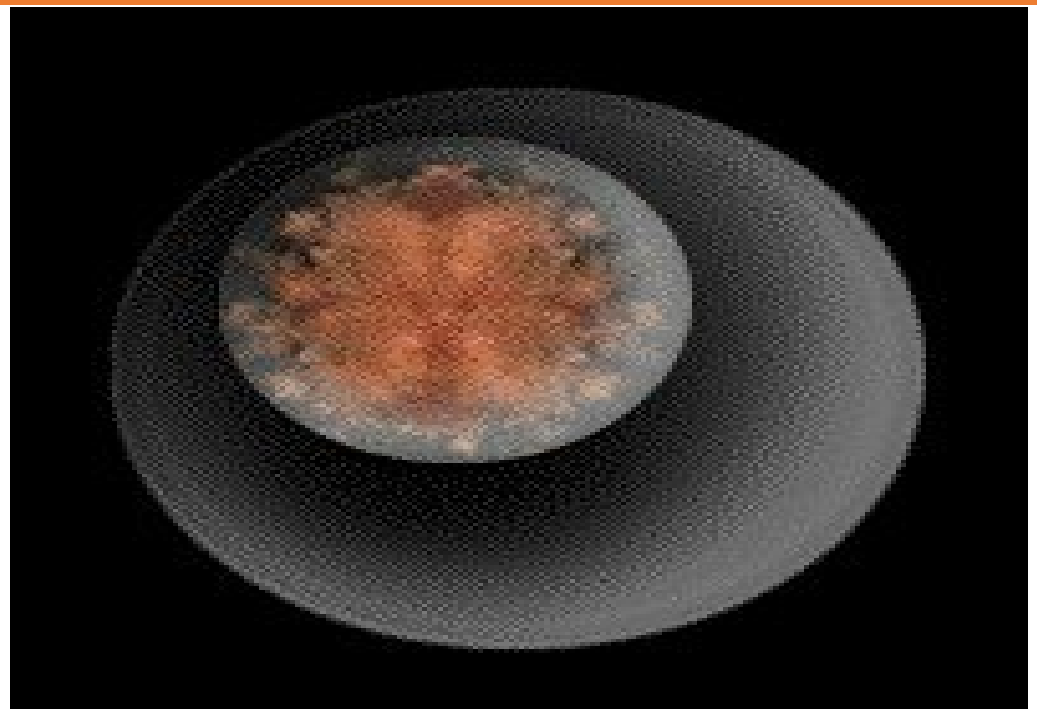
- It starts by the end of the DNA replication and lasts until the beginning of mitosis.

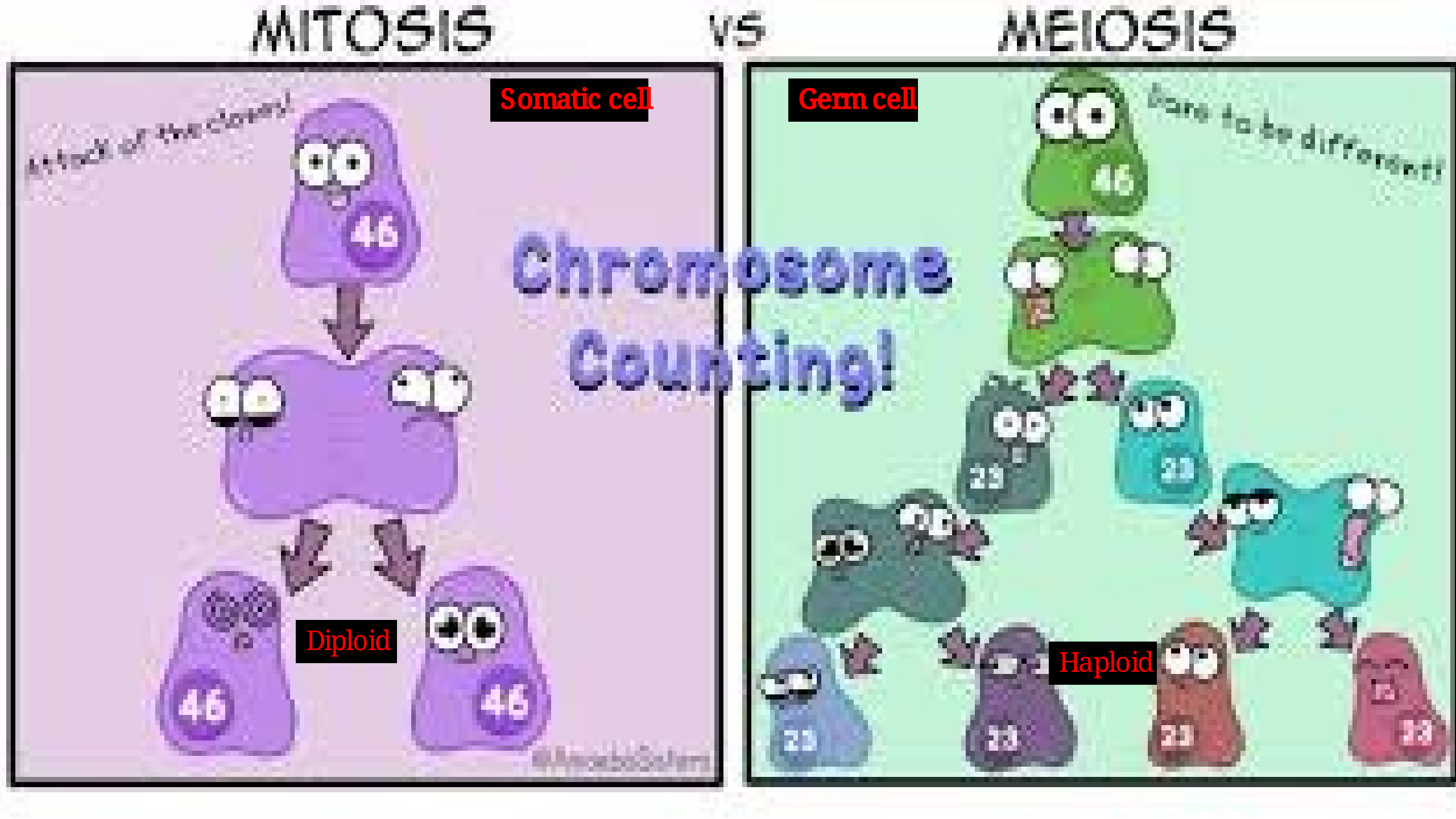
1- Proteins and energy essential to mitosis are stored.

2- Duplication of the centrosome is *completed*.



Cell division



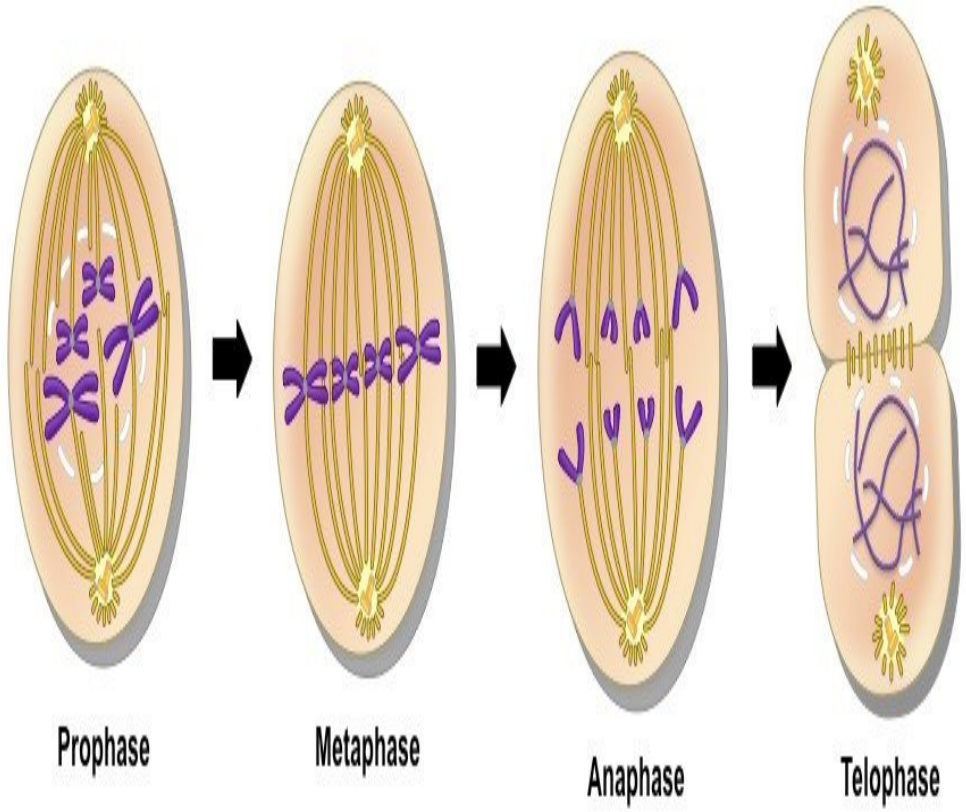

MITOSIS
vs
MEIOSIS
Somatic cell
Germ cell
Chromosome Counting!
Diploid
Haploid
46
23

Mitosis

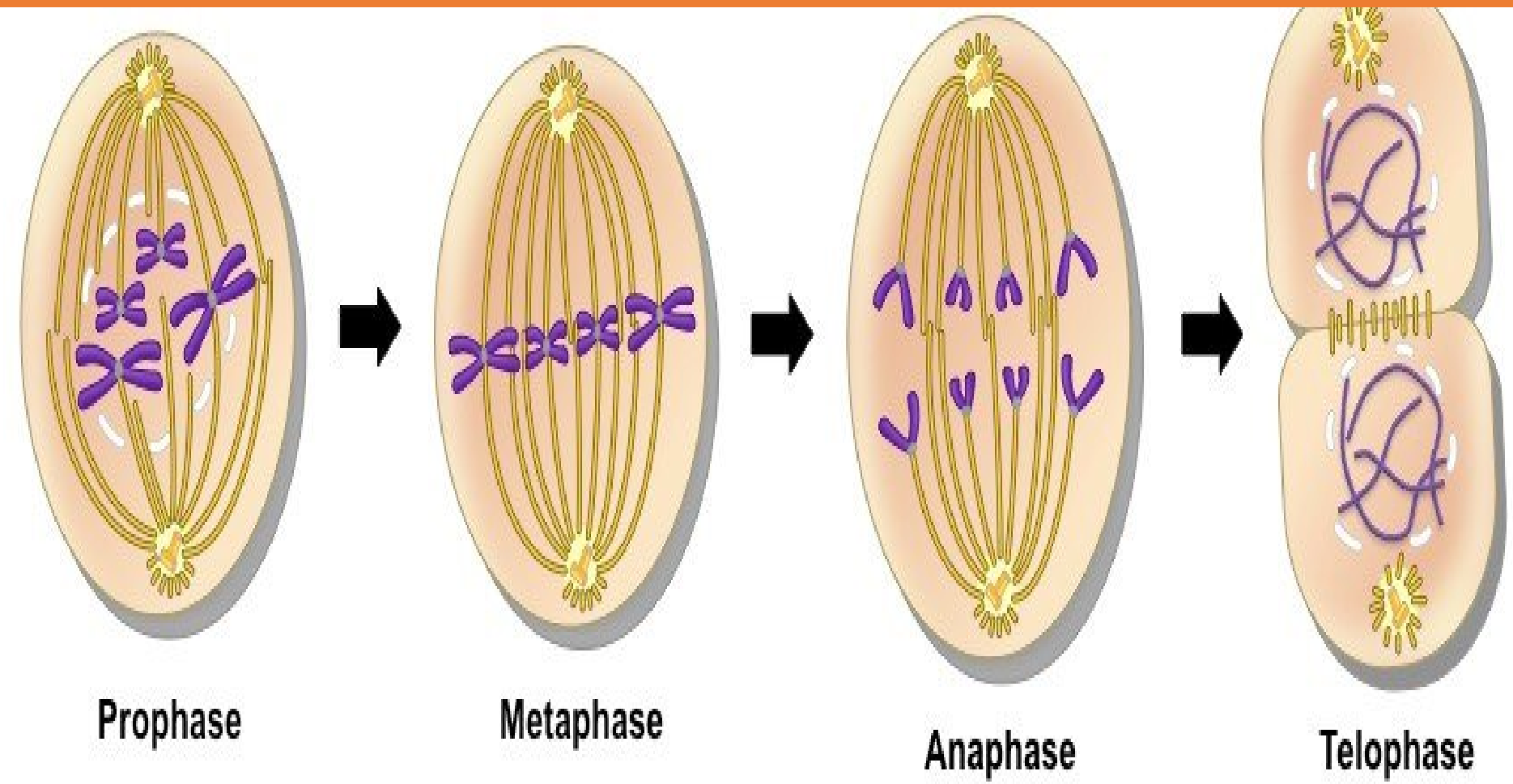
- **Definition:** division of the somatic cell into two daughter cells identical to the mother cell.
- **Function:**

1- Growth and development of the organism.

2- Renewal and repair of cells.



Mitosis



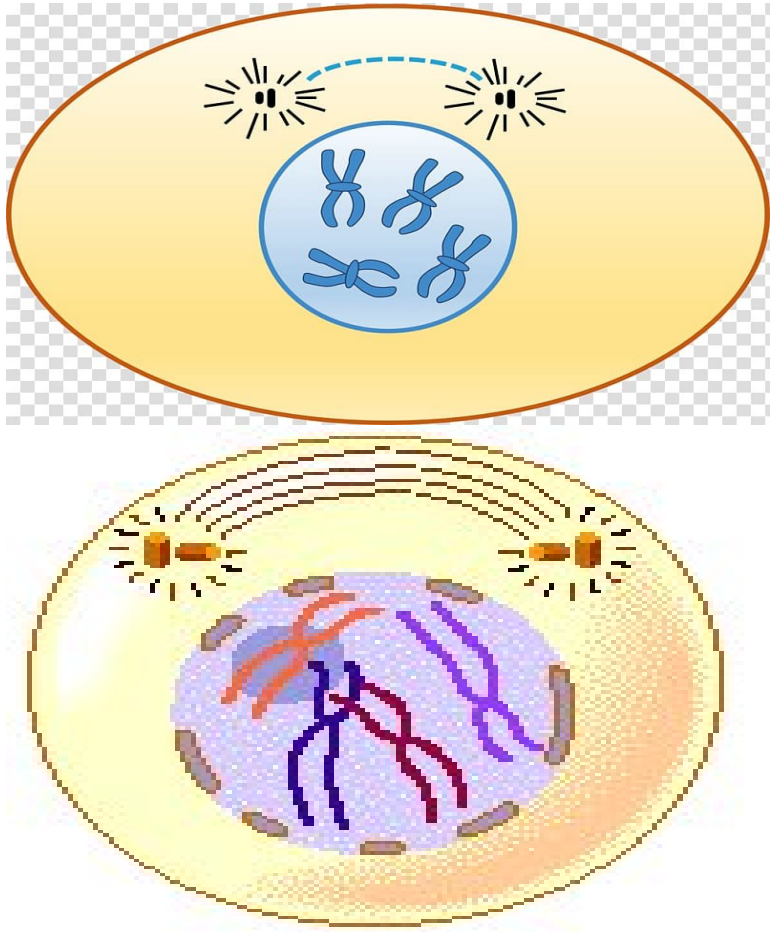
I-Prophase

1- The *nucleolus* disappears.

2- Condensation of *chromatin* gives rise to 46 rod-shaped short d-chromosomes.

3- Each pair of *centrioles* migrates to opposite pole of the cell forming the mitotic spindles.

4- The *nuclear envelope* breaks up into small vesicles

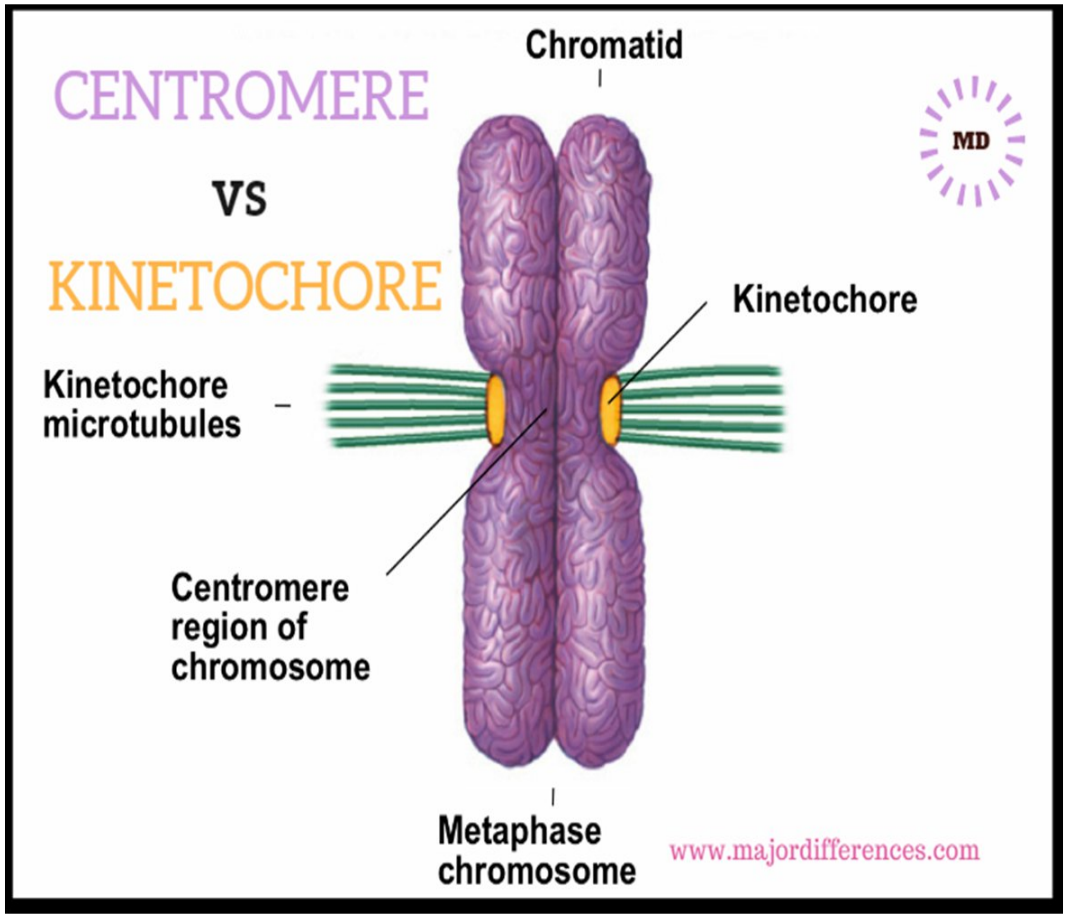


2-Metaphase

1- The 46 d-chromosomes become maximally condensed.

2- The chromosomes *aligned at the equatorial plate* of the cell.

- Each pair of sister chromatid is attached to the mitotic spindles at *the kinetochore*.

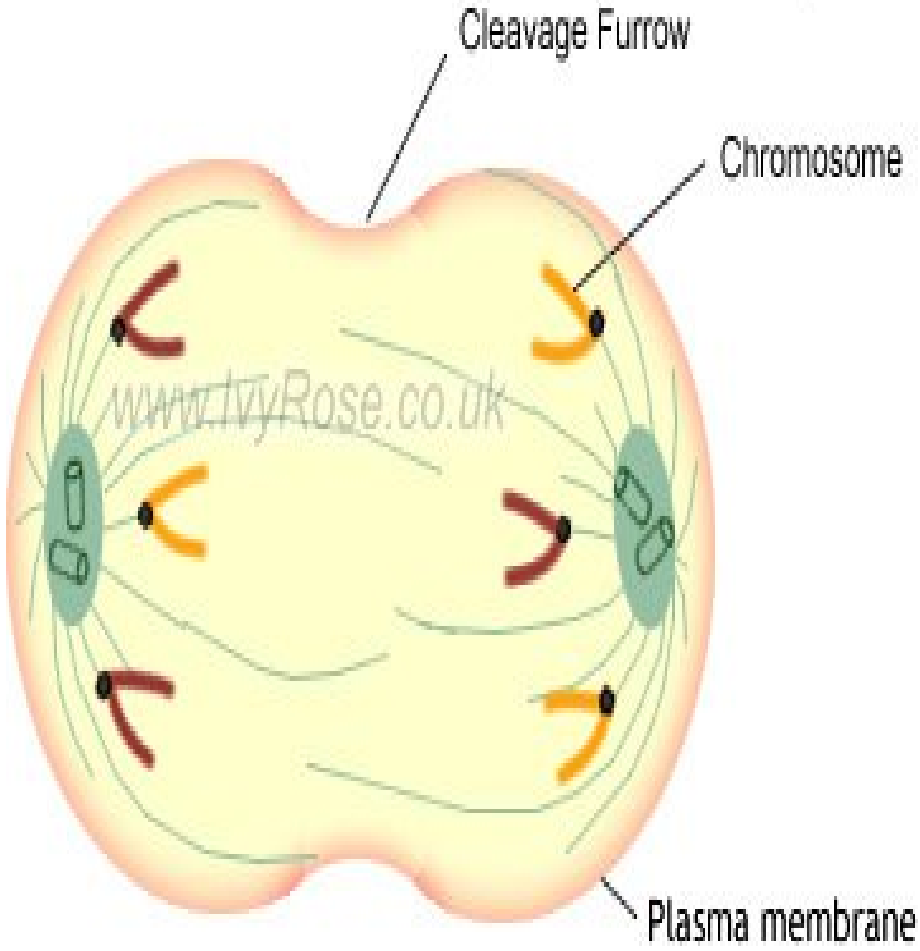


3-Anaphase

1-*Division of the centromere* results in the separation of the sister chromatids.

2- Each 46 chromatids migrate toward the opposite poles of the cell.

3- In late anaphase, *a constriction (cleavage furrow)* develops at the equatorial plate of the cell.



4-Telophase

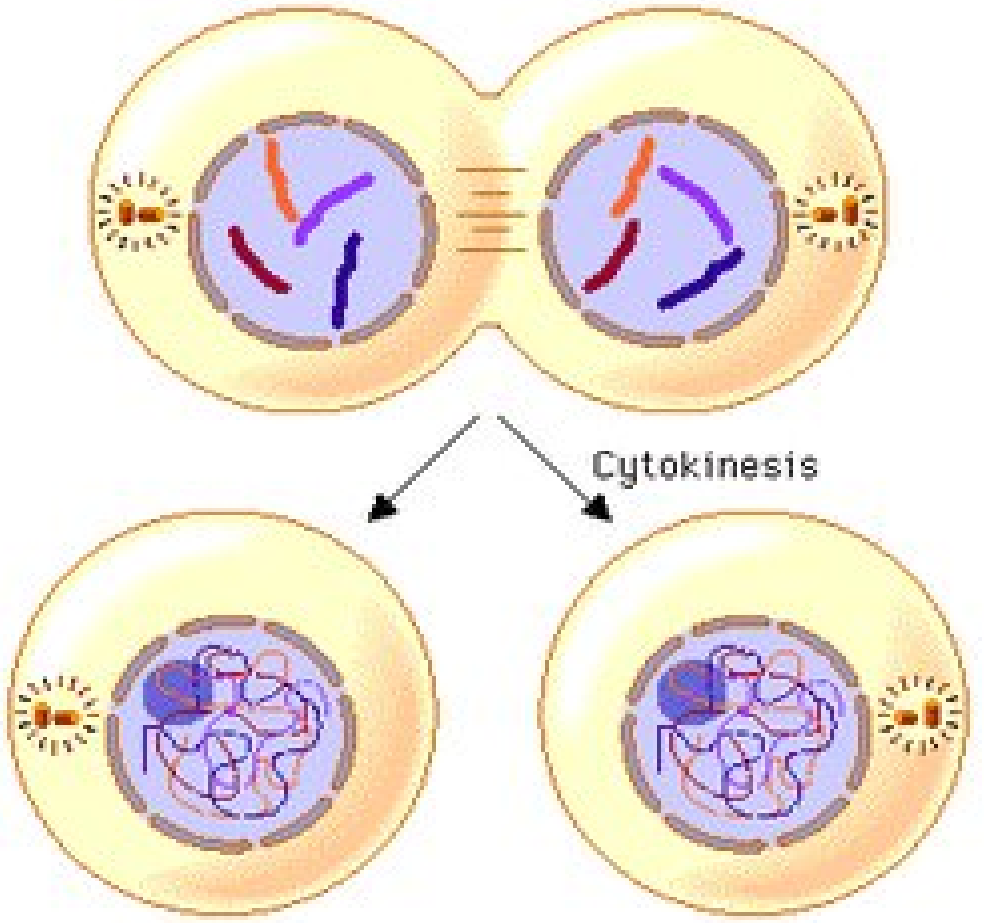
1- The *mitotic spindle* disappears.

2- The *nucleolus* reappears.

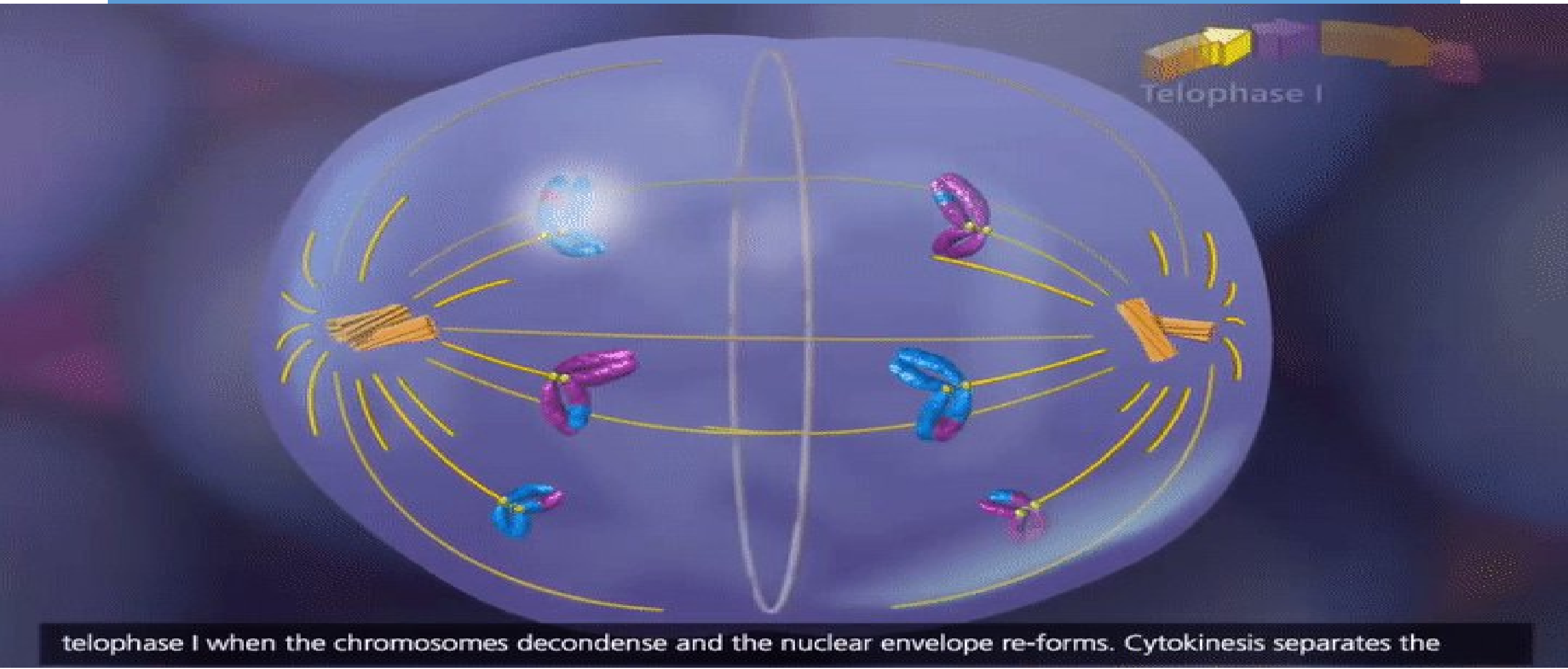
3- The *chromosomes* start uncoiling (46 s-chromosomes).

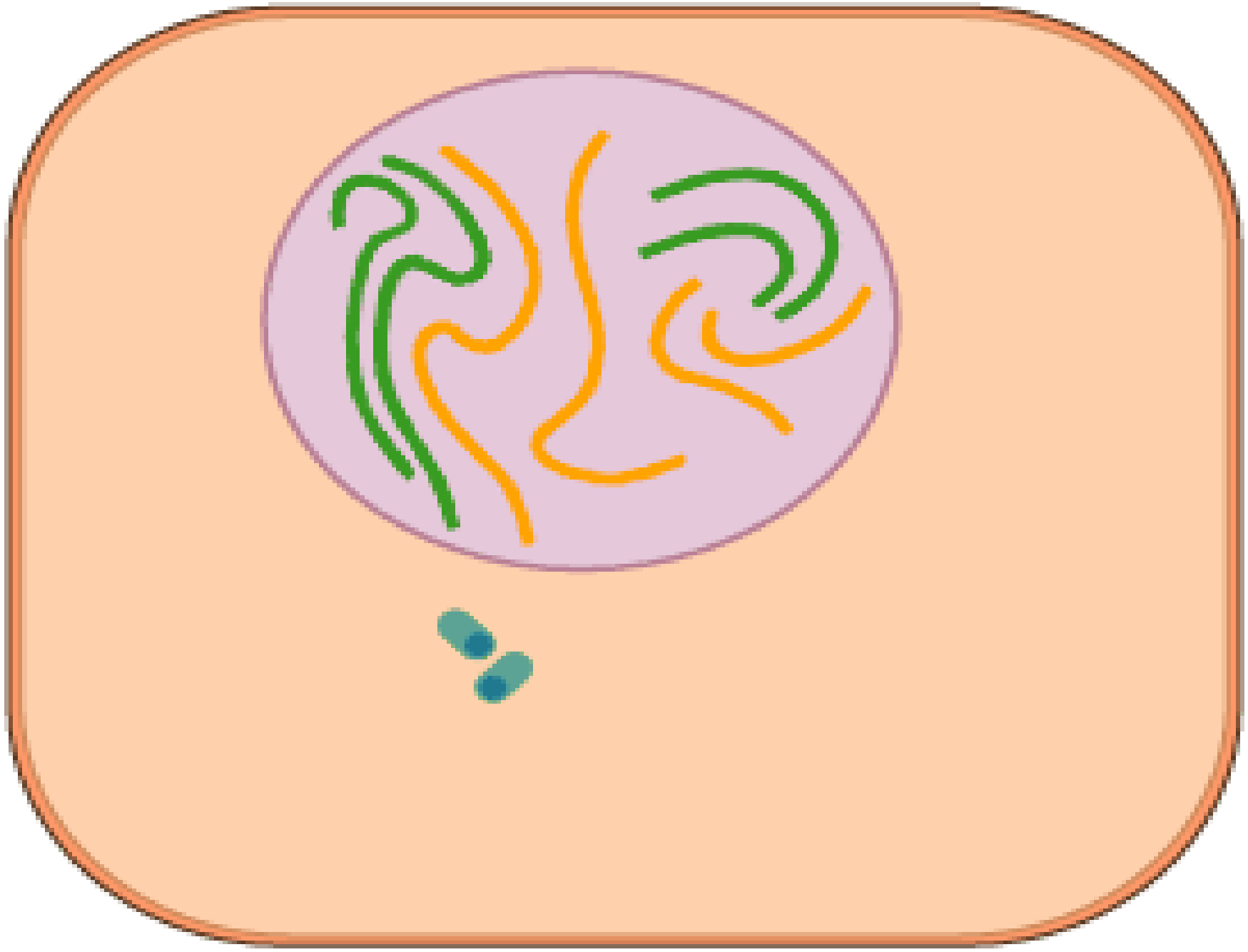
4- The *nuclear envelope* is reformed around the new sets of chromosomes.

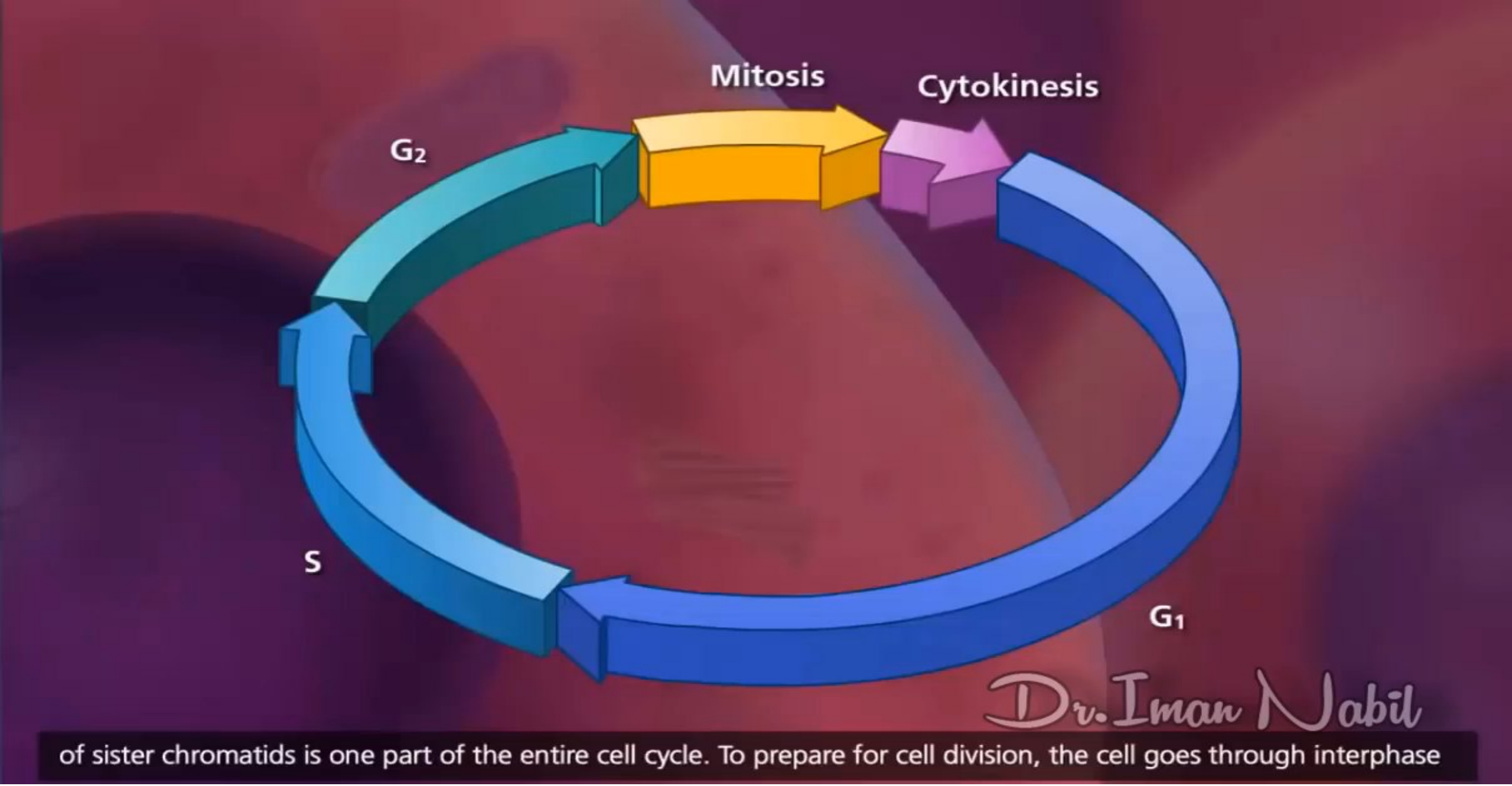
5- Division of the *cytoplasm* (cytokinesis): the cleavage furrow becomes deeper due to the formation of a contractile ring of microfilaments until it divides the cytoplasm and its organelles in half resulting into two daughter cells.



4-Telophase


Telophase I
telophase I when the chromosomes decondense and the nuclear envelope re-forms. Cytokinesis separates the



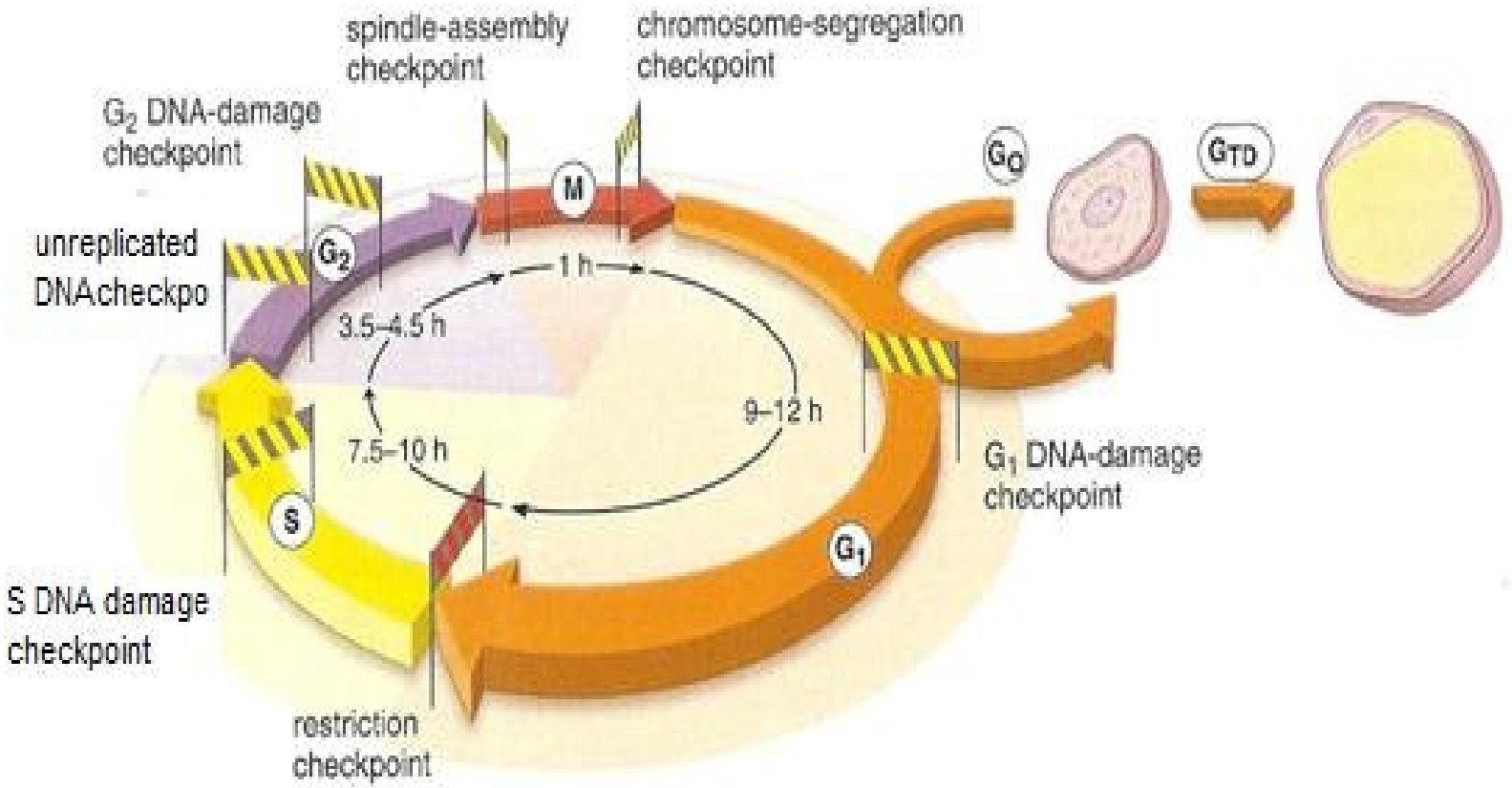


of sister chromatids is one part of the entire cell cycle. To prepare for cell division, the cell goes through interphase

Regulation of the cell cycle

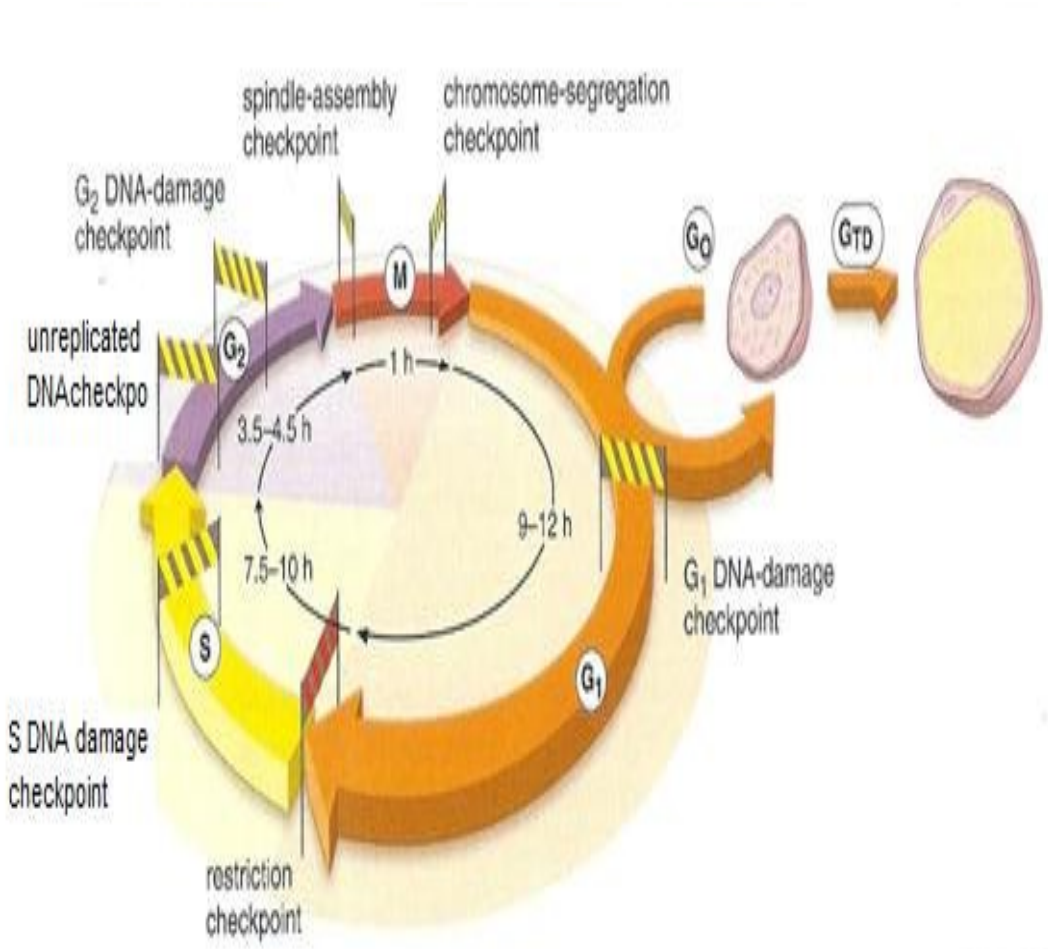
- The cell cycle is regulated by growth factors that control cell proliferation to keep its coordination with the needs of the living organism.
- Several ***checkpoints*** control the transition between the cycle stages.
- Checkpoints detect external or internal problems and stop the cycle until the problem solved.

Checkpoints of cell cycle

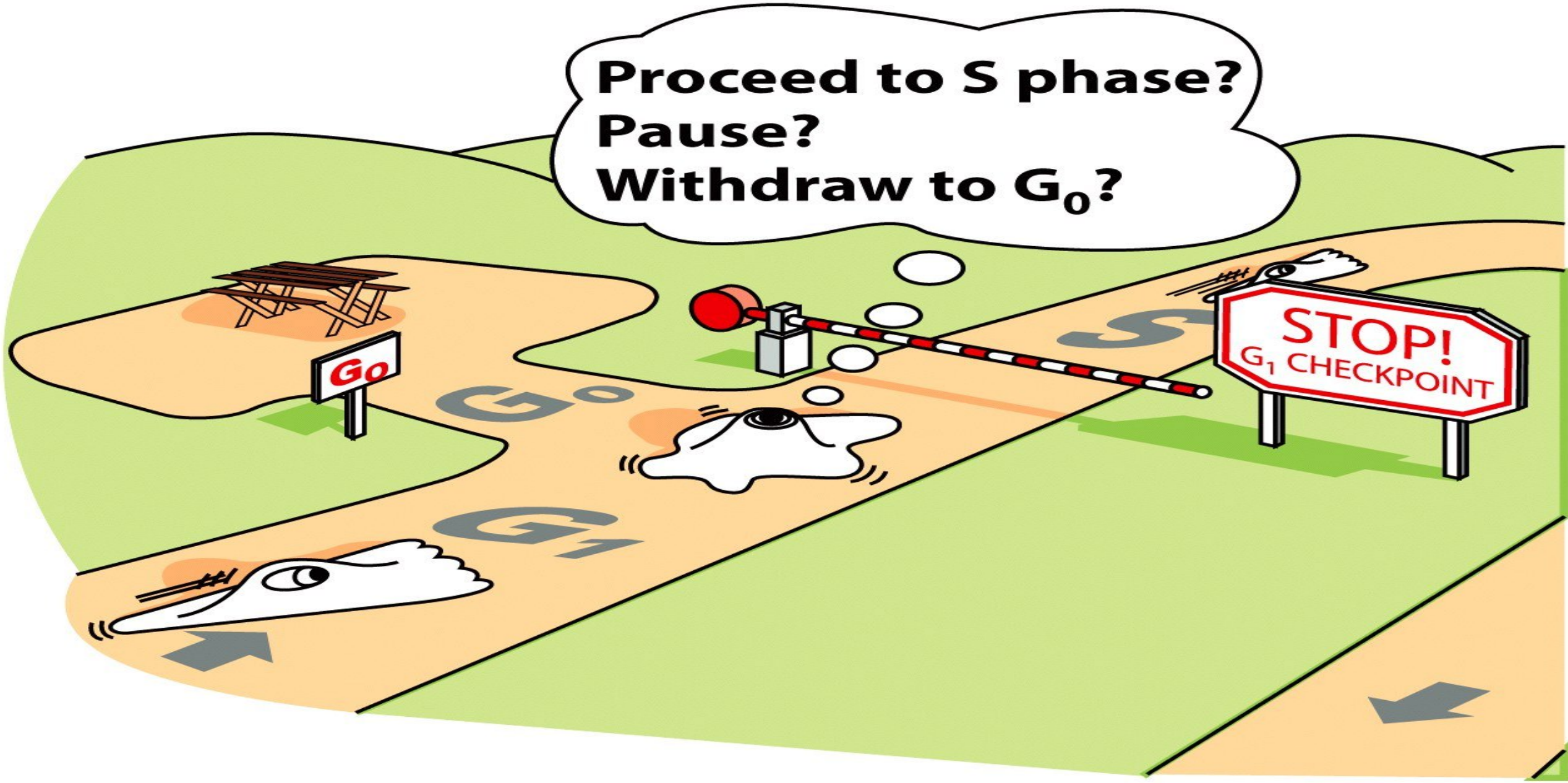


1-The restrictioncheckpoint

- It occurs in the G1 phase.
- It detects *the cell size& its interactions with the surrounding environment.*
- Cells that do not receive appropriate growthstimuli do not progress past this point (G1 phase) and will be die by apoptosis.

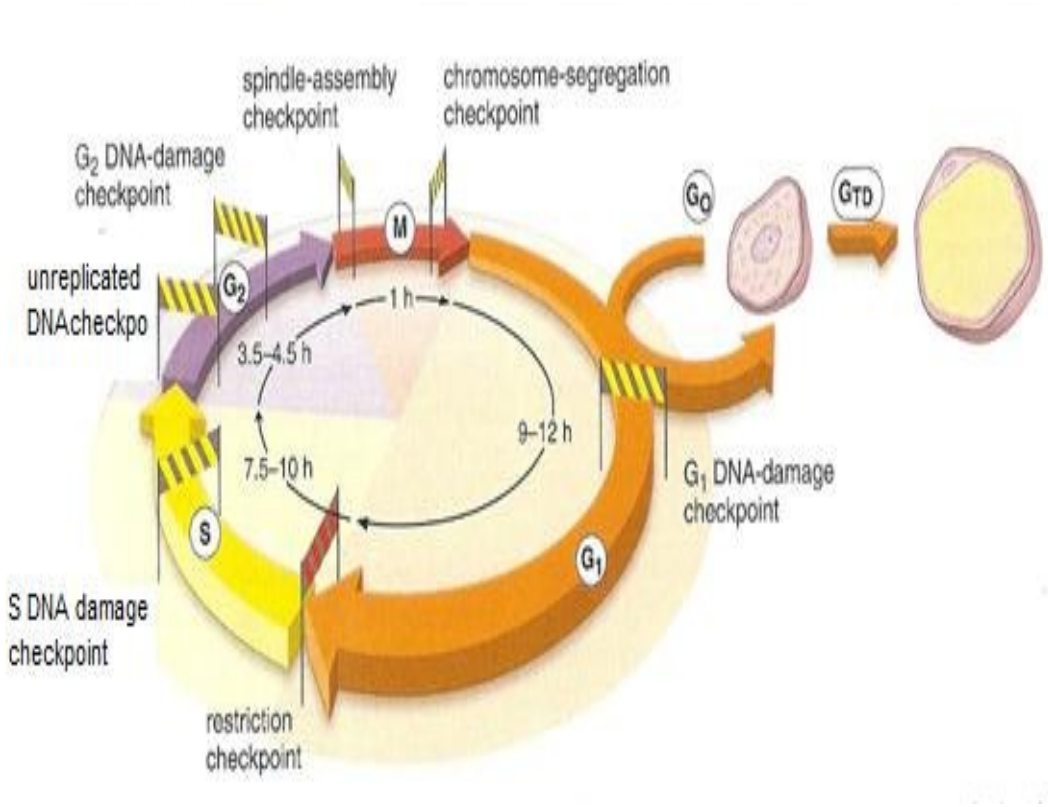


It is the most important checkpoint in the cell cycle.



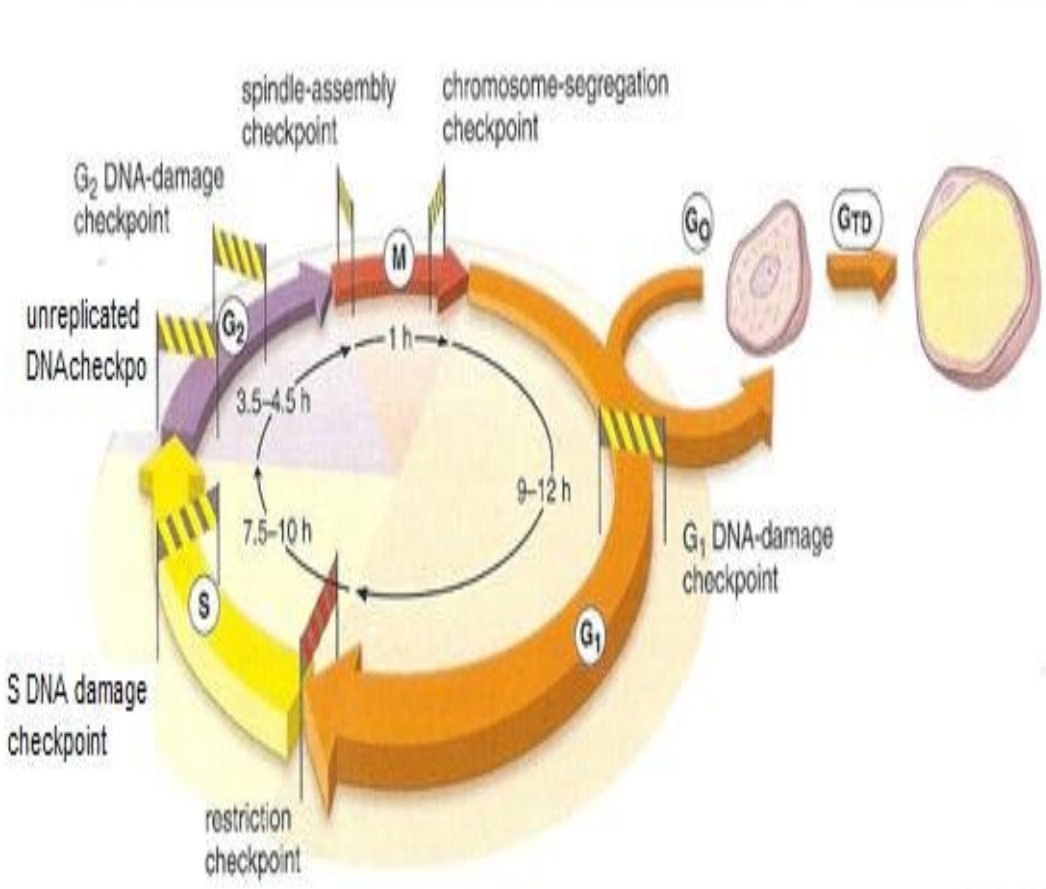
2-DNA damage checkpoints

- It occurin G1, S, and G2 phases.
- It blockscell cycle progression until repair of the damaged DNA or cell apoptosis occurs.



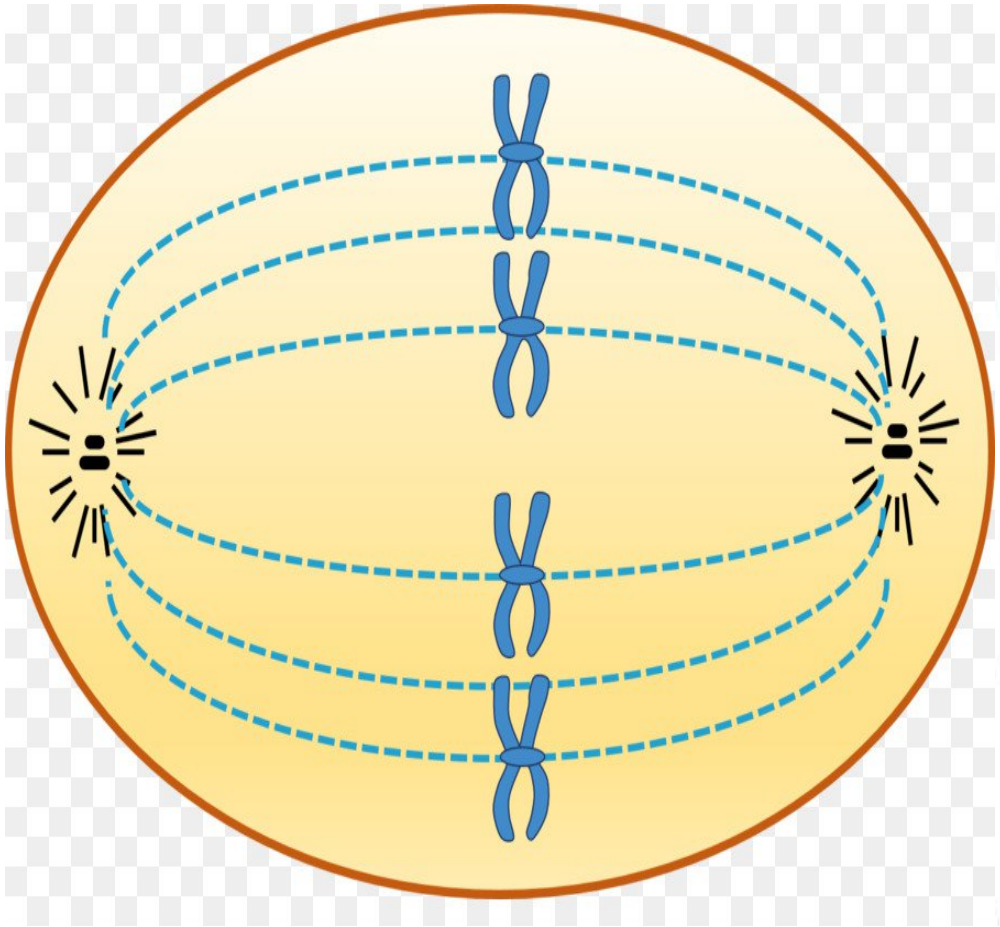
3-The unreplicated DNA checkpoint

- It occurs in the G_2 phase.
- It prevents progression of the cycle into the mitosis before complete synthesis of DNA.



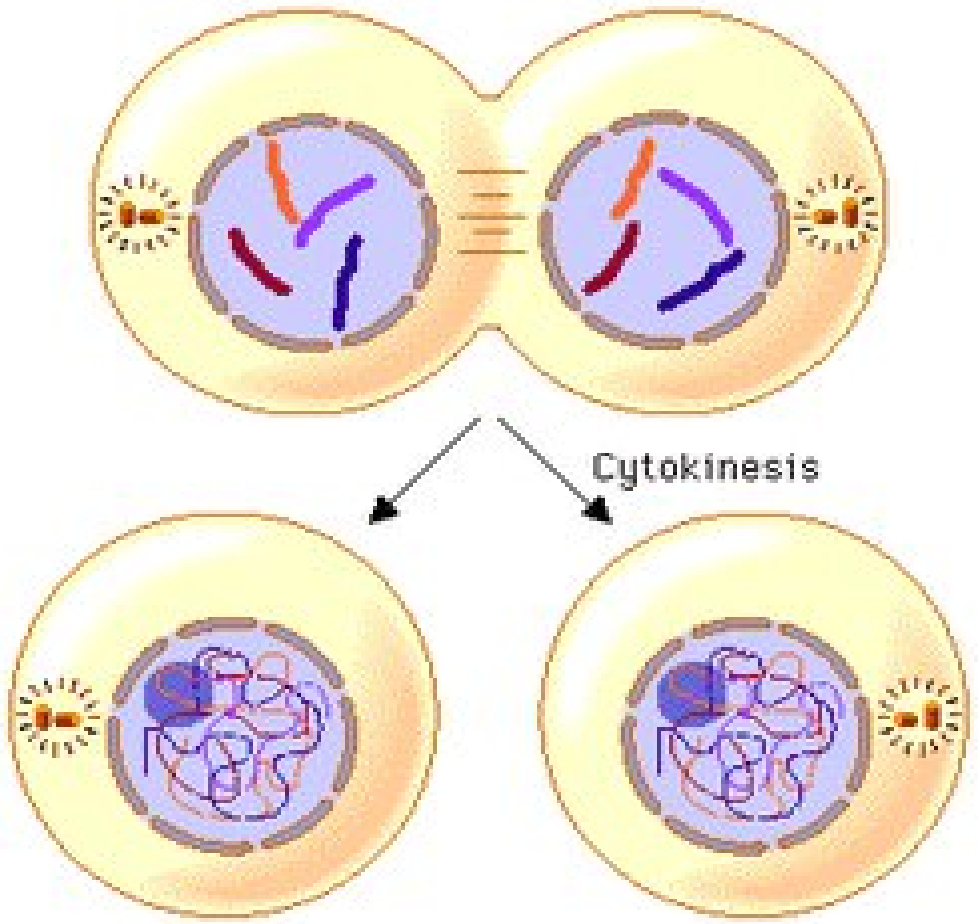
4- The spindle-assembly checkpoint (the metaphase checkpoint)

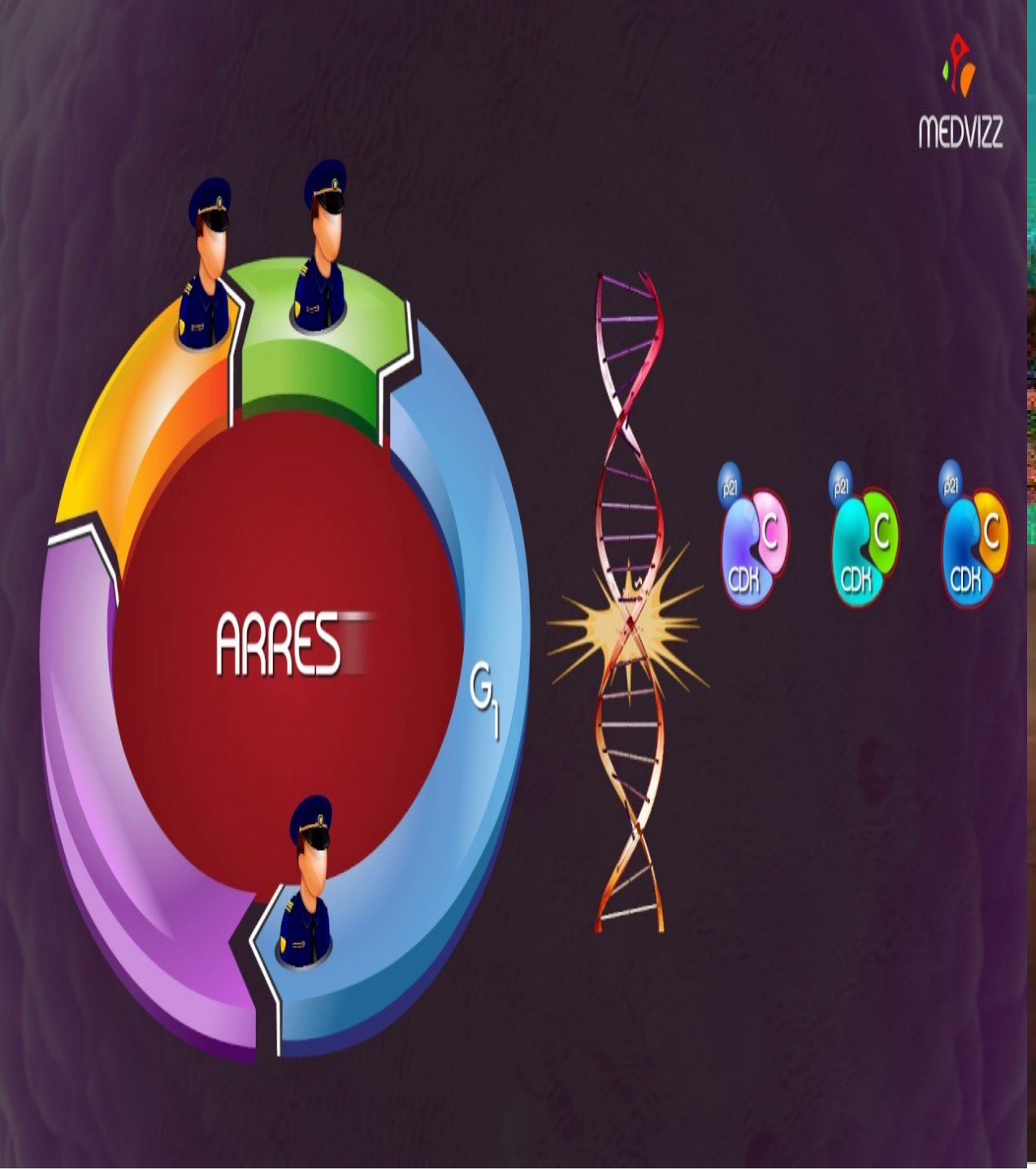
- It occursin mitosis
- It preventsentryinto anaphase until all chromosomes have attached properly to the mitotic spindle.

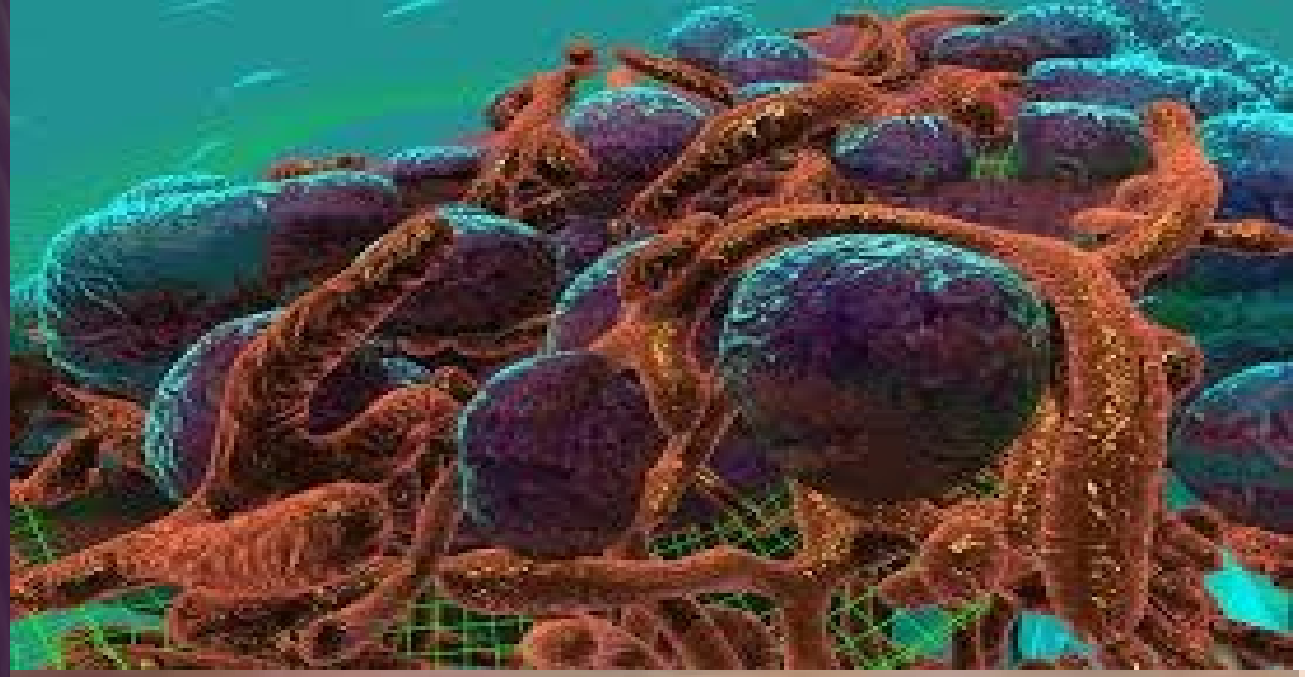


5- The chromosome-segregation checkpoint

- It occurs in telophase.
- It prevents the cytokinesis until all of the chromosomes have been correctly separated.




MEDVIZZ
ARRES
G1
p21
C
CDK
p21
C
CDK
p21
C
CDK

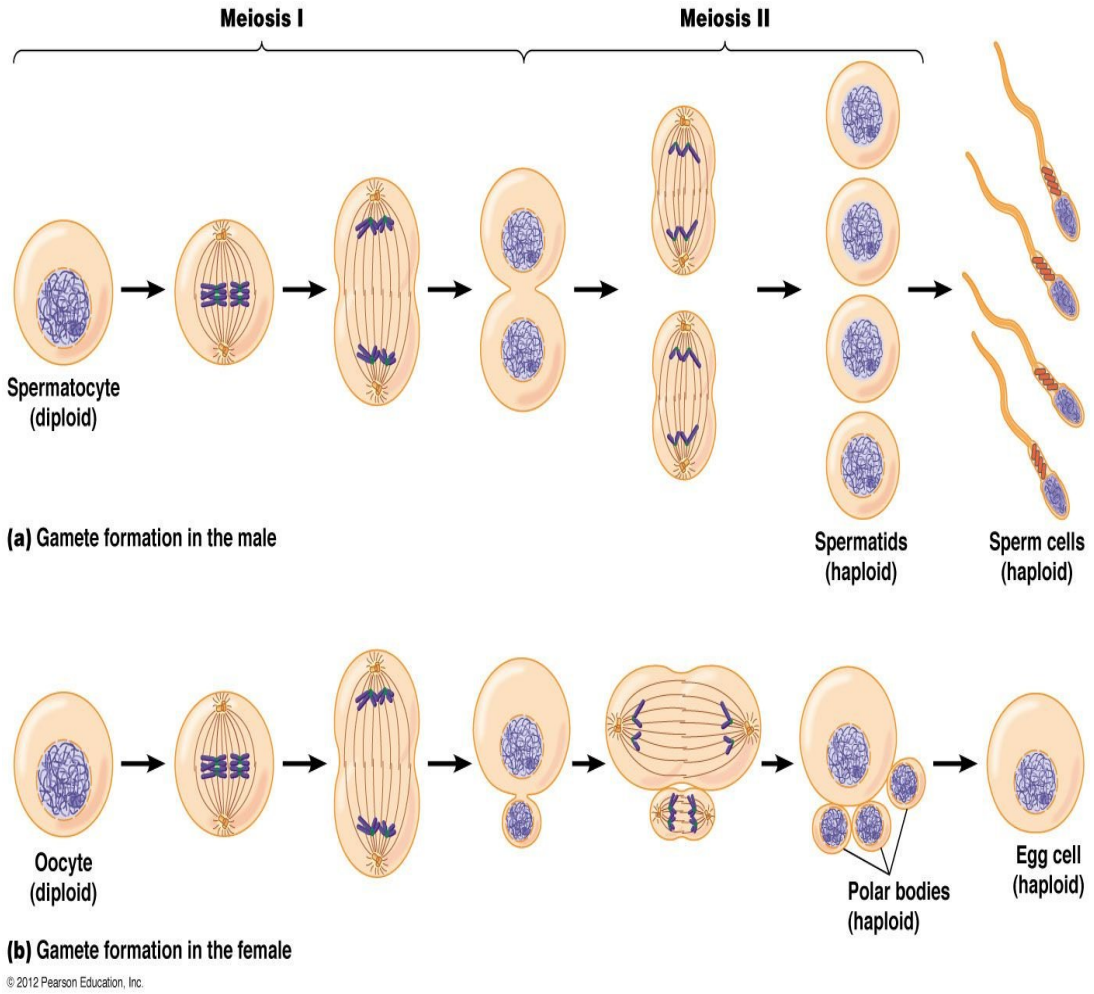


الحمد لله

الذي عافاني مما ابتلى به غيري

Meiosis

- It occurs in *germ cells* and results in the formation of gametes.
- It results information of *4 daughter cells* (each contains 23s-chromosomes=haploid number).
- It consists of two successive divisions; *without an intervening S phase*.



I-First meiotic division (reductional division)

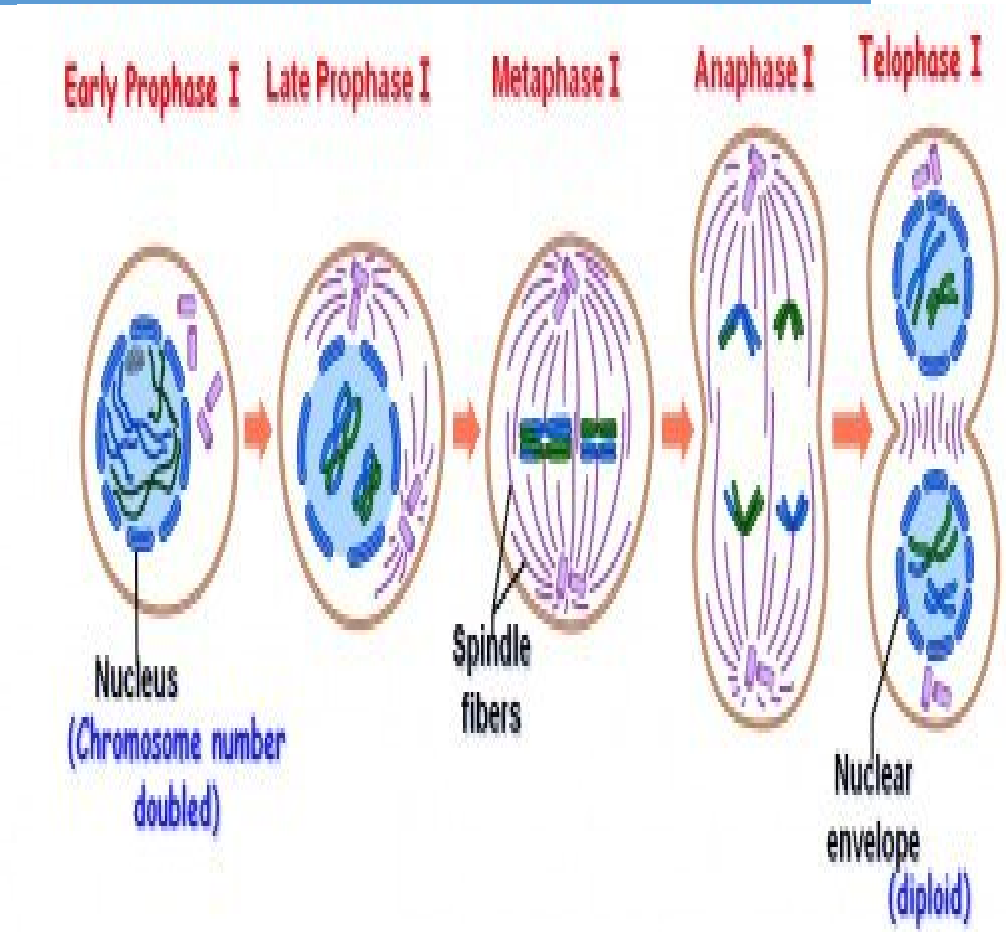
It is preceded by interphase with an *S phase*, in which the chromosomes are replicated (46 s chromosomes → 46 d chromosomes).

1-Prophase I:

A- *Pairing of the homologous chromosomes* occurs forming tetrads(bivalent)

B- Crossing-over occurs between the chromatids of the homologous chromosomes so that each homologous chromosome is no longer solely paternal or maternal but a mixture of both.

3- The nucleolus and the nuclear envelope disappear and the mitotic spindle is formed.



I-First meiotic division (reductional division)

2- Metaphase I:

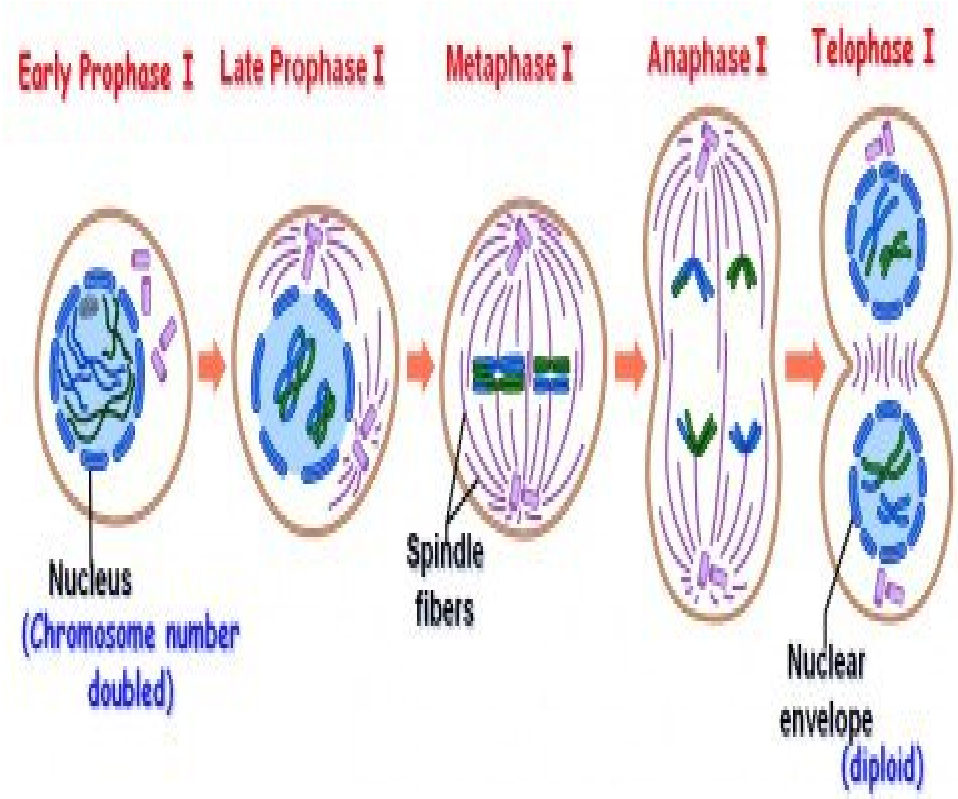
The *paired chromosomes* arrange themselves at the equatorial plate of the cell.

3- Anaphase I:

The centromeres *do not divide*, instead, each chromosome of homologous pairs moves separately towards the opposite poles of the cell.

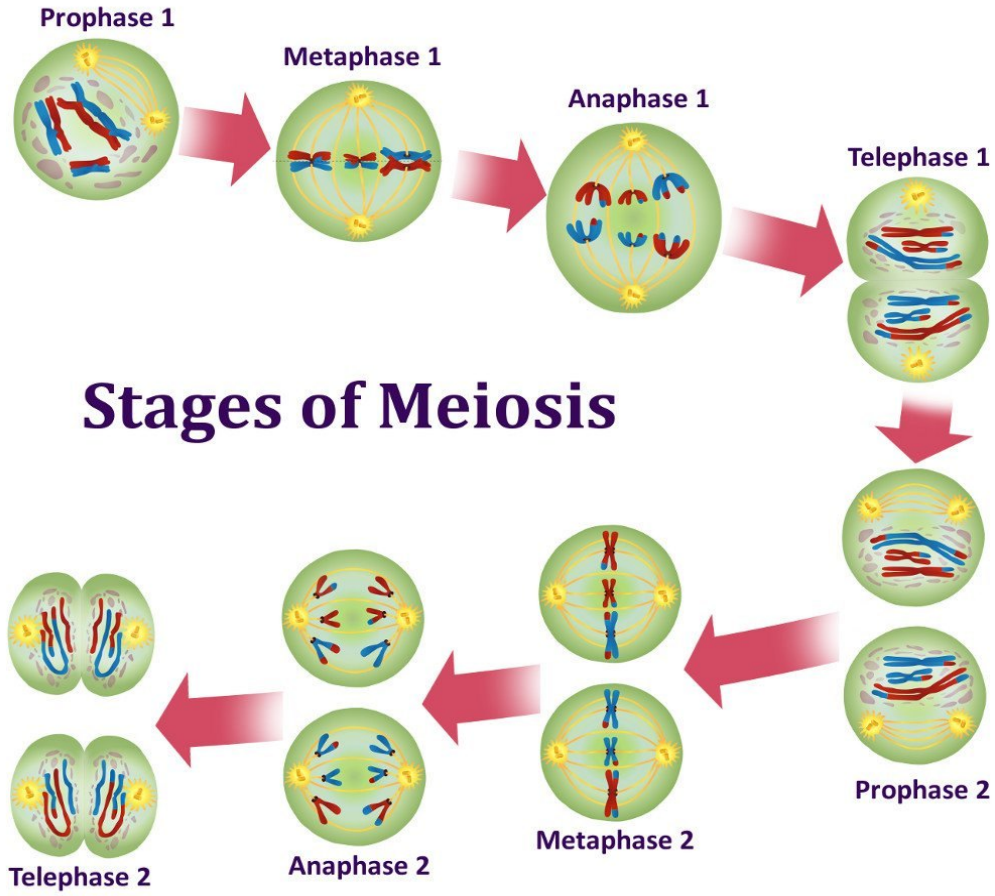
4- Telophase I:

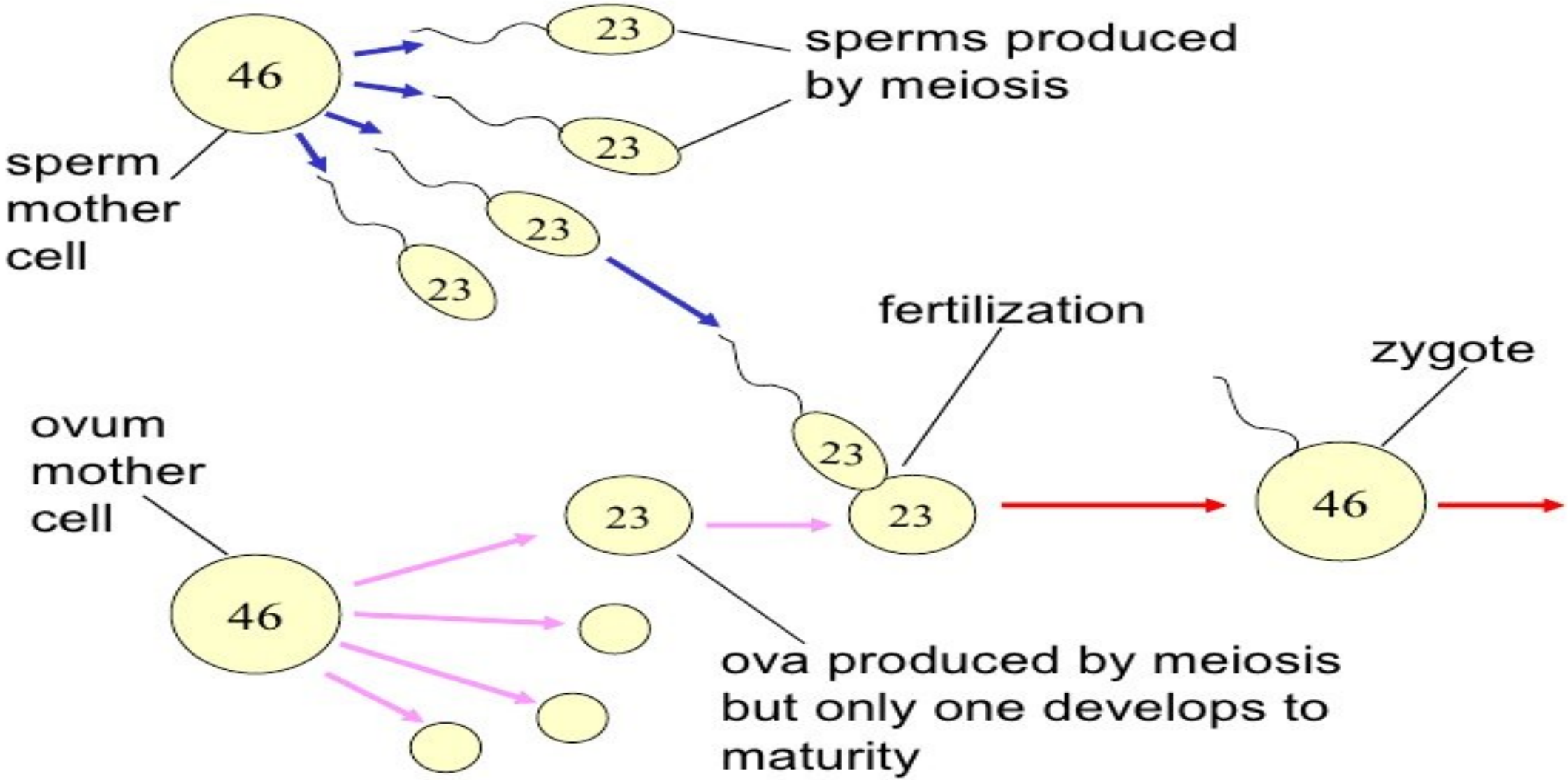
Cytokinesis occurs results in two daughter cells each containing the haploid number(23d-chromosomes).

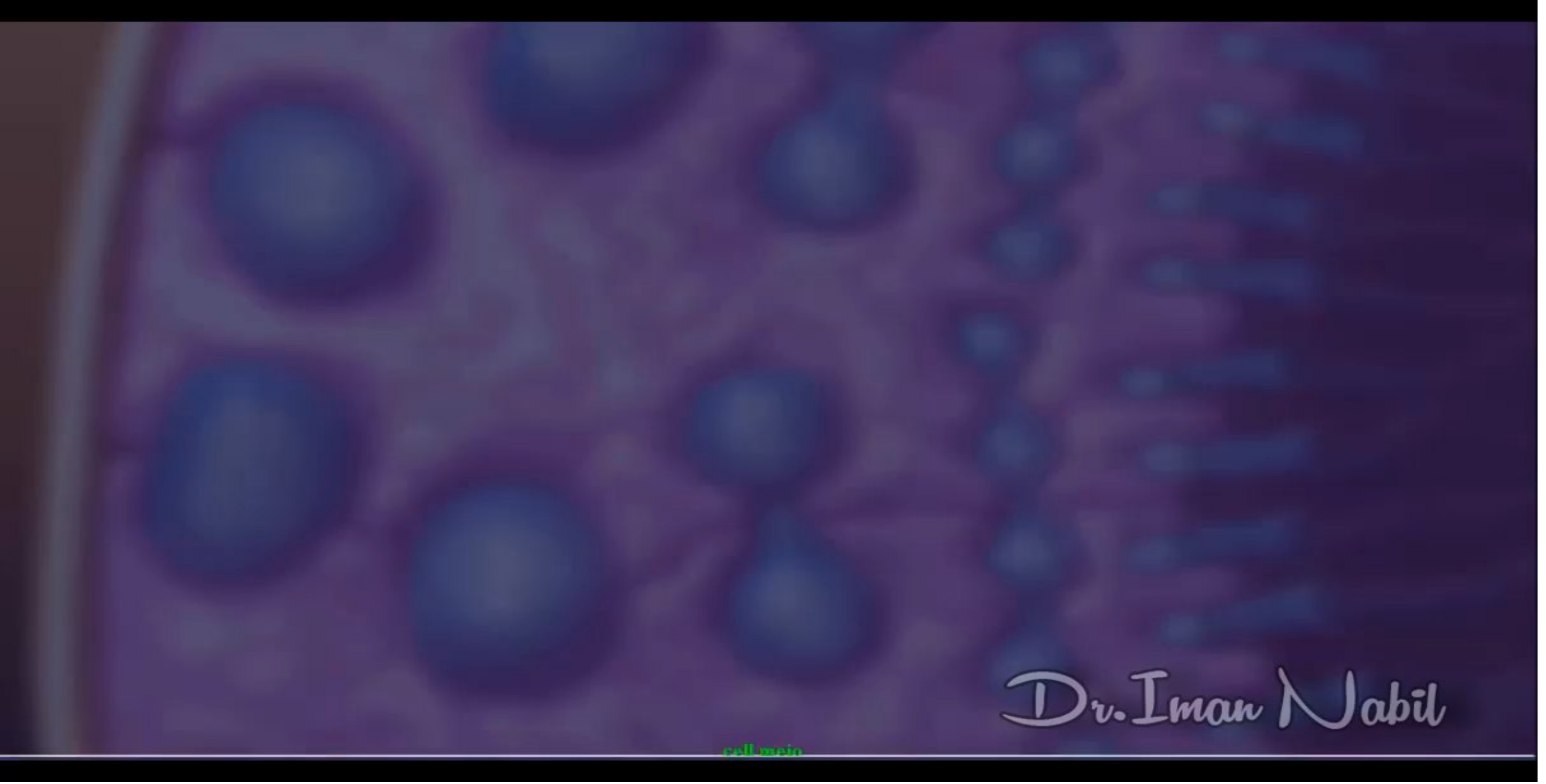


II-Second meiotic division (equatorial division)

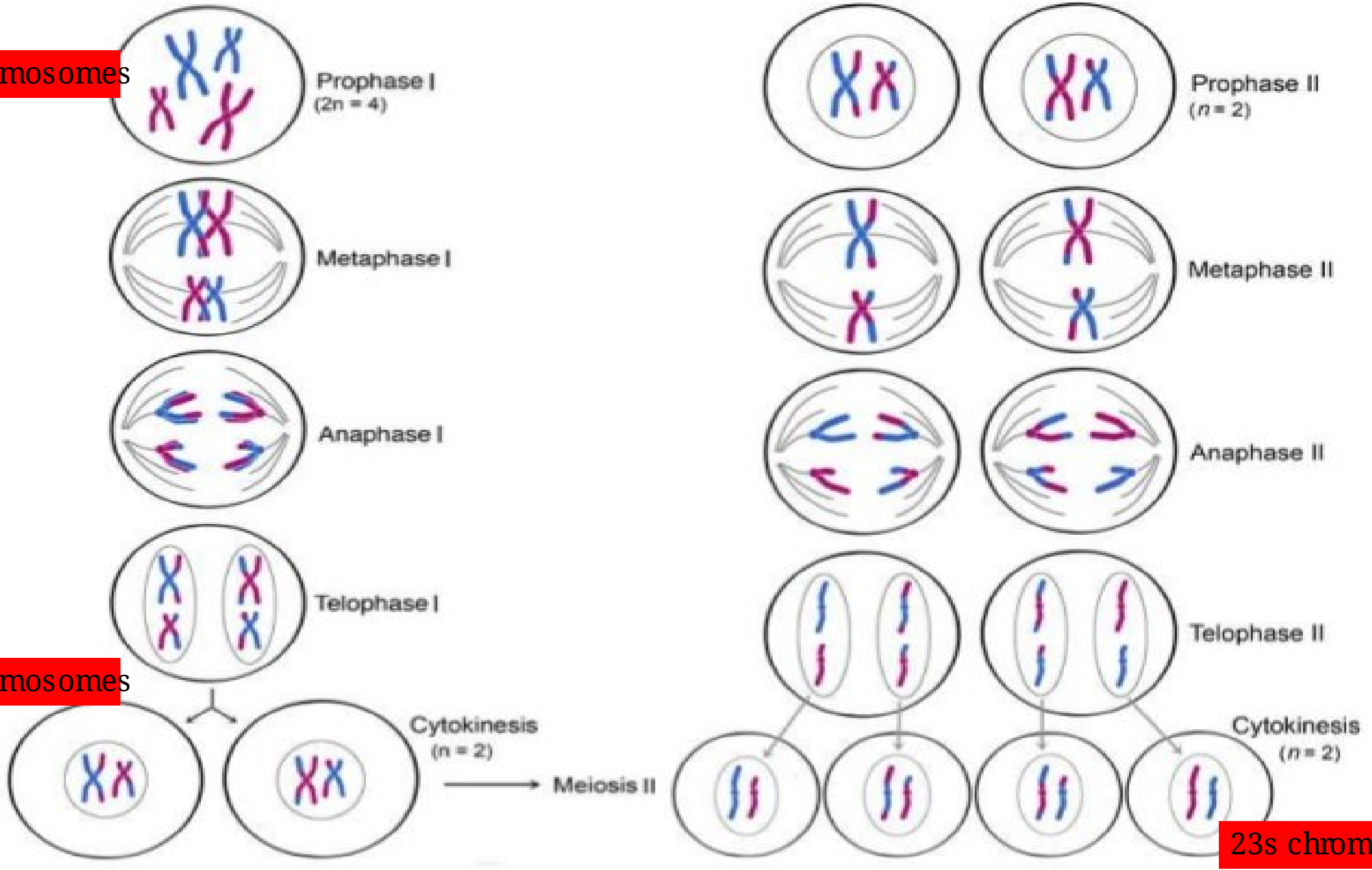
- It is similar to mitosis but, it is *not preceded* by S phase.
- It results in formation of *4 daughter cells*, each contains 23 s-chromosomes (haploid number).




46
sperm mother cell
23
23
23
23
sperms produced by meiosis
fertilization
23
zygote
46
ovum mother cell
46
23
23
ova produced by meiosis but only one develops to maturity


Dr. Iman Nabil
cell wall

46 d chromosomes



23 d chromosomes

23s chromosomes

1-Types of cells	Somatic cells	Germ cells of testis & ovaries
2- Number of division	Single division	2 successive divisions: Meiosis I & Meiosis II.
3- Interphase	Preceded by interphase with S phase	Meiosis I preceded by interphase with S phase, Meiosis II not preceded by S phase.
3- Prophase	No crossing over	Meiosis I: Crossing over occurs
4-Metaphase	46 d chromosomesarranged individually at the equatorial plane of the cells.	In Meiosis I :23 bivalent arranged at the equatorial plane of the cells.
5- Anaphase	Each chromosome divides at centromere into 2 chromatids	In MeiosisI: each chromosome of a bivalent moves apart.
6- Cells produced	Two daughter cellswith diploid number of chromosomes (46 S) Daughtercells are genetically identical	Four daughter cellswith haploid number of chromosomes (23 S) Daughtercells are genetically variable.

1- Preceded S phase	Present (the cell enter the prophase with 46 d chromosomes).	Absent (the cell enter the prophase with 23 d chromosomes).
2- Prophase	Pairingof homologous chromosomes result in 23 tetrad. Crossing over occurs between each tetrad .	No pairing No crossing over.
2- Metaphase	23 tetradarranged at theequatorial plane of the cells.	23 d chromosomesarranged individually at the equatorial plane of the cells.
3- Anaphase	No division of the centromere. Each chromosomemoves independently to the opposite pole of the cell.	Centromere splits so each chromatidmoves independently to the opposite pole of the cell.
4- Telophase	Cytokinesis results in 2 daughter cells each with 23 d chromosomes.	Cytokinesis results in 4 daughter cells each with 23 S chromosomes.

Which checkpoint prevents the passage of the cell into mitosis?

1- The chromosome segregation checkpoint.

2- The spindle assembly checkpoint.

3- The unreplicated DNA checkpoint.

4- Restriction point.

Which checkpoint prevents the passage of the cell into mitosis?

1- The chromosome segregation checkpoint.

2- The spindle assembly checkpoint.

3- The unreplicated DNA checkpoint.

4- Restriction point.


Thank You