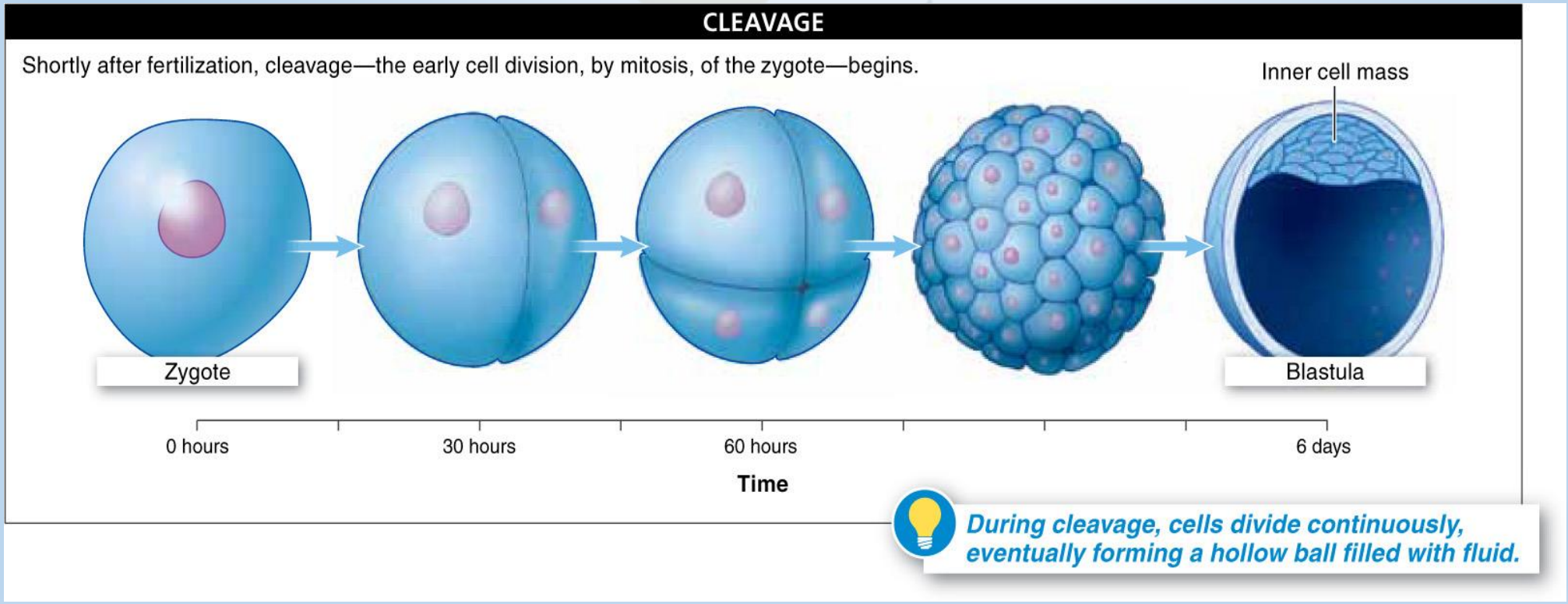
Biology Grade 9

CHAPTER 8: CONFORMED REPRODUCTION OF GENETIC INFORMATION

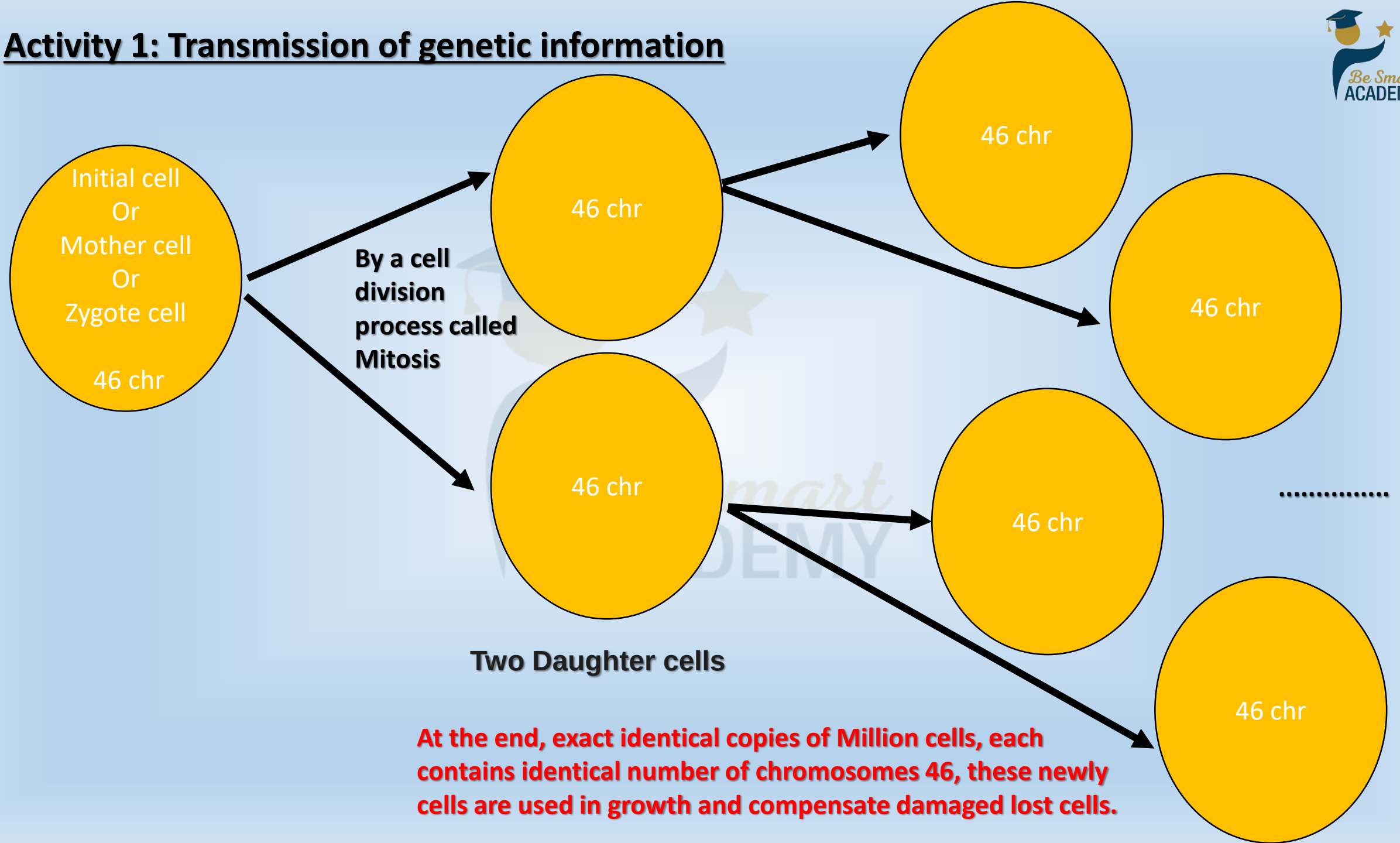
INSTRUCTOR: SUHAIB AUDI

❖ Introduction:

- All cells of an organism are derived from successive divisions of the zygote.
- They all carry, except gametes, the same number of chromosomes and the same genetic information.
- How is the genetic information, carried by the chromosomes, transmitted to all the cells of the body?



Activity 1: Transmission of genetic information

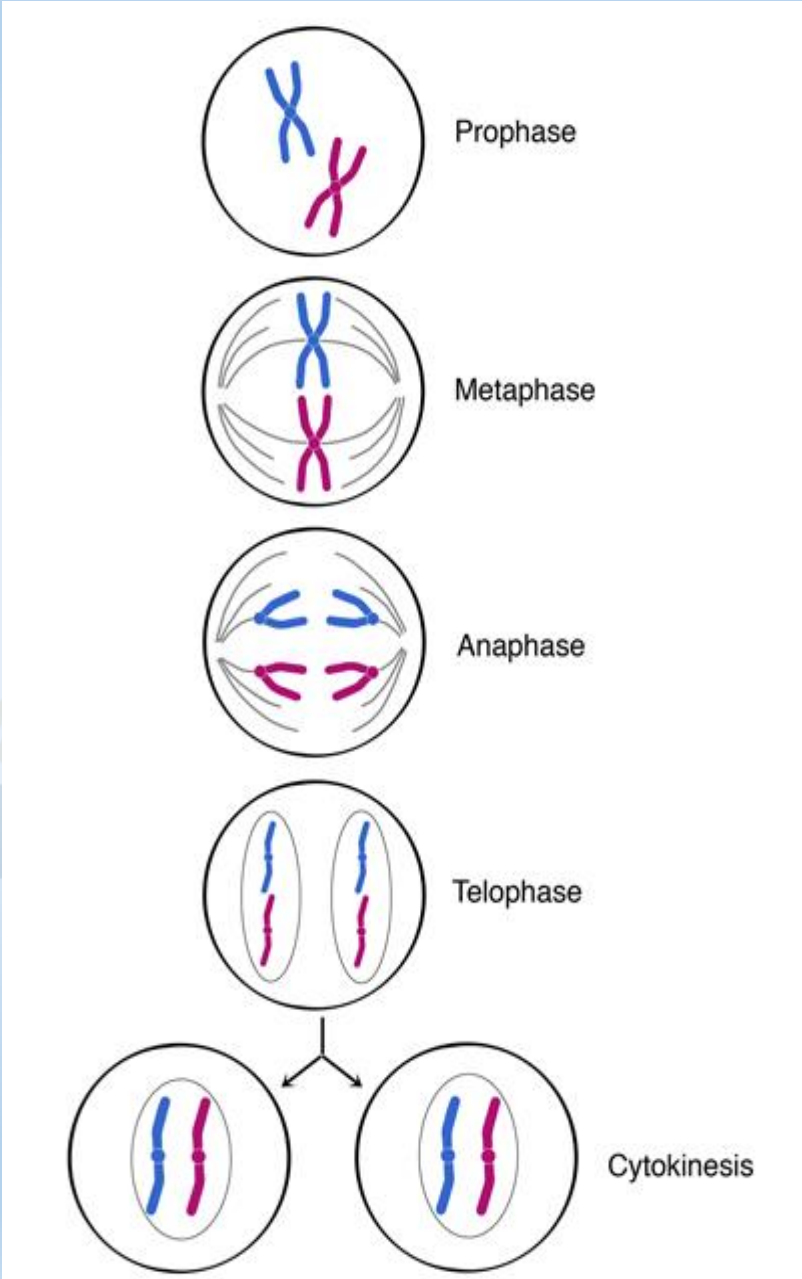


At the end, exact identical copies of Million cells, each contains identical number of chromosomes 46, these newly cells are used in growth and compensate damaged lost cells.

❖ Mitosis:

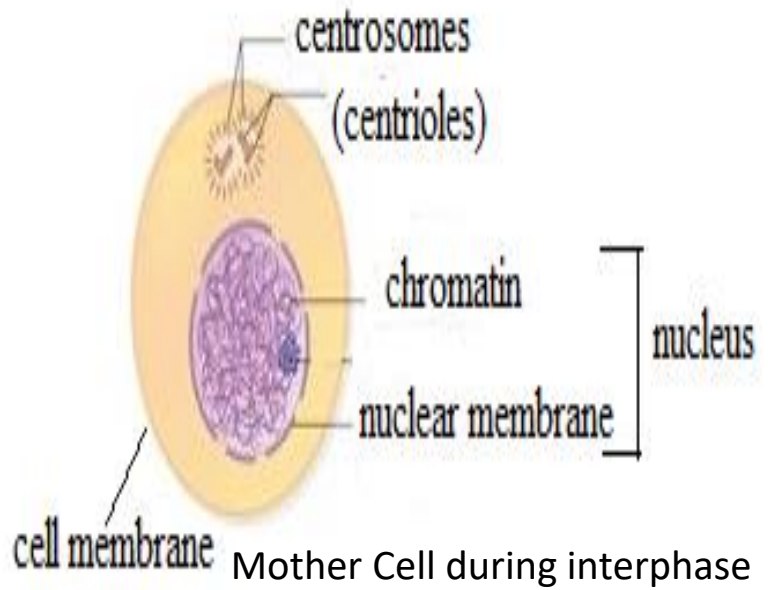
- DEFINITION: It is a process of cell division of somatic cells to produce new cells conserving the genetic information.
- OBJECTIVE: Helps in growth by increasing cell number and its renewal: replace old cells by new ones.
- PHASES: It starts by prophase followed by metaphase. After that, anaphase starts which ends by telophase.
  - **Before mitosis and after it there is a phase that restores any lost material during mitosis. It is called interphase.**

➢ **Cellular cycle**: It is divided into two parts: **Interphase** and **mitosis**.



❖ **Interphase:** 46 chr [Decondensed] Each of 2 chromatids

- Centrosomes are present.
- Chromosomes appear as chromatin inside the nuclear membrane.

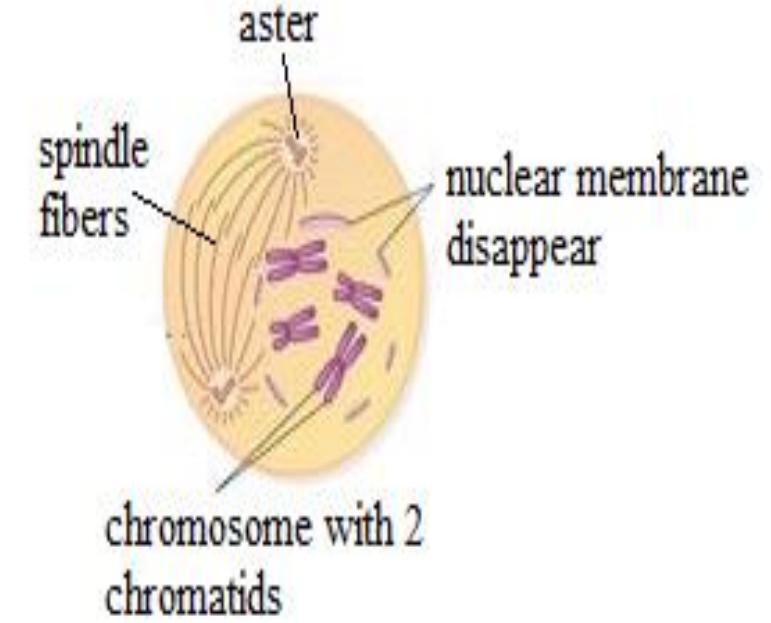


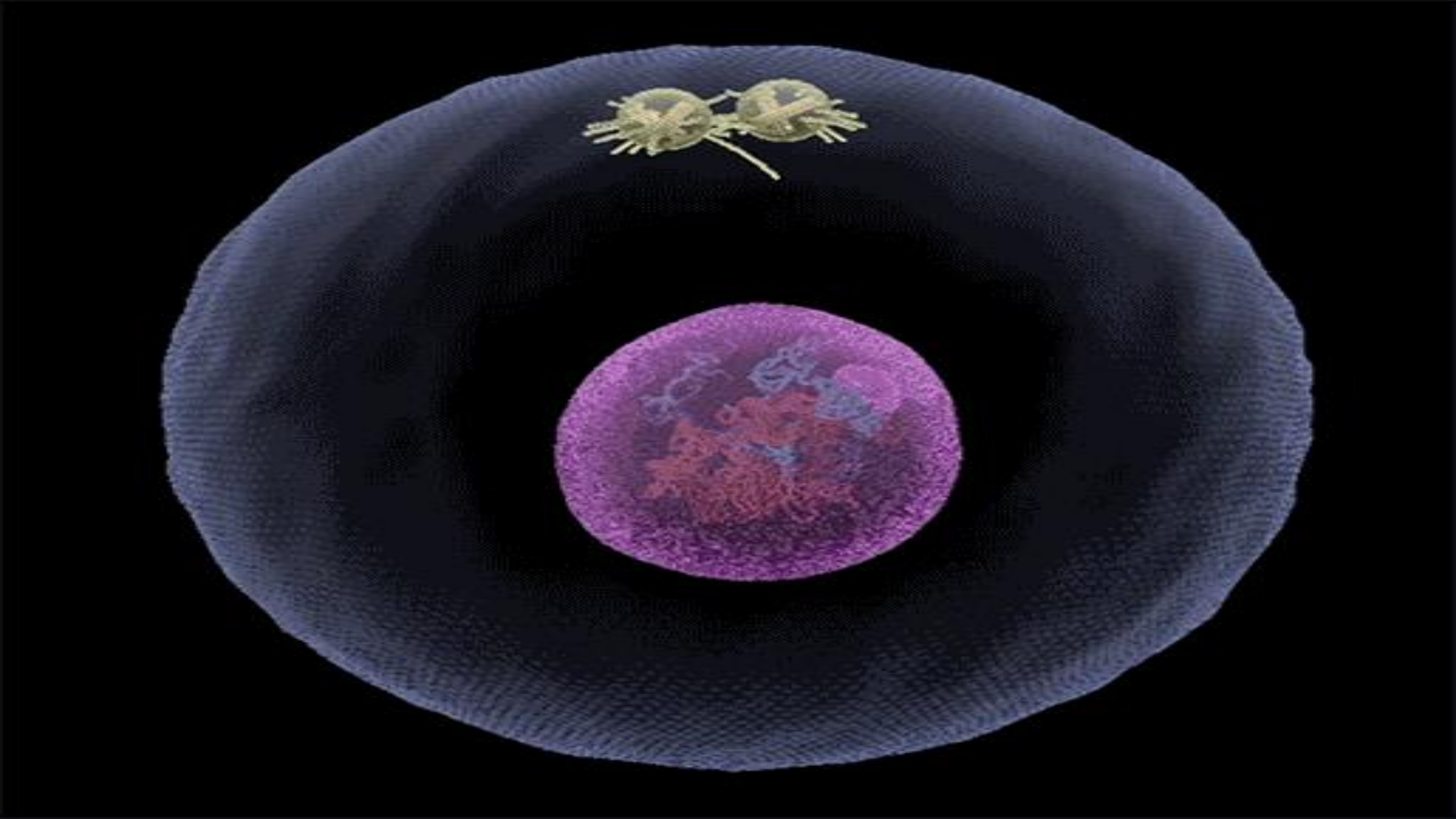
Mother Cell during interphase

❖ **Mitosis**

1. Prophase: 46 chr [Condensed] Each of 2 chromatids

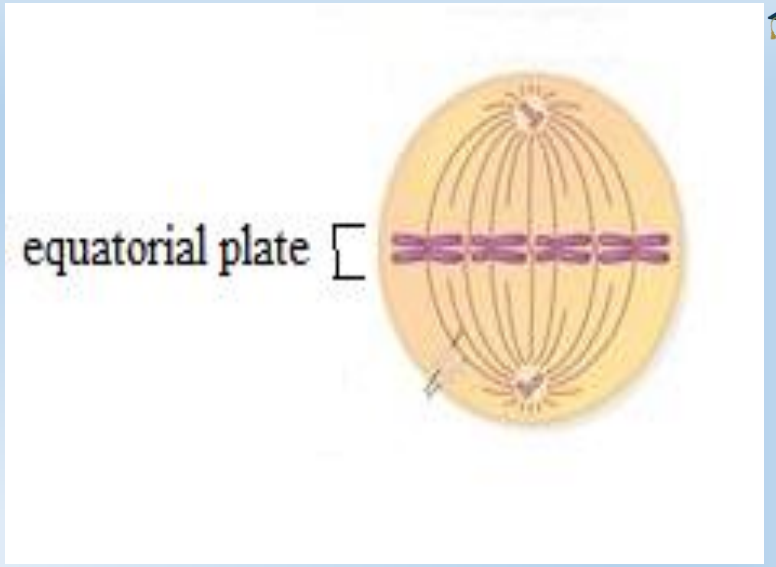
- Chromatin condenses into chromosomes.
- The chromosomes become visible, and each is formed of two chromatids connected by a centromere.
- The nuclear membrane disappears.
- The centrosome duplicates and transforms into asters.
- Spindle fibers (achromatic fibers) begin to form.





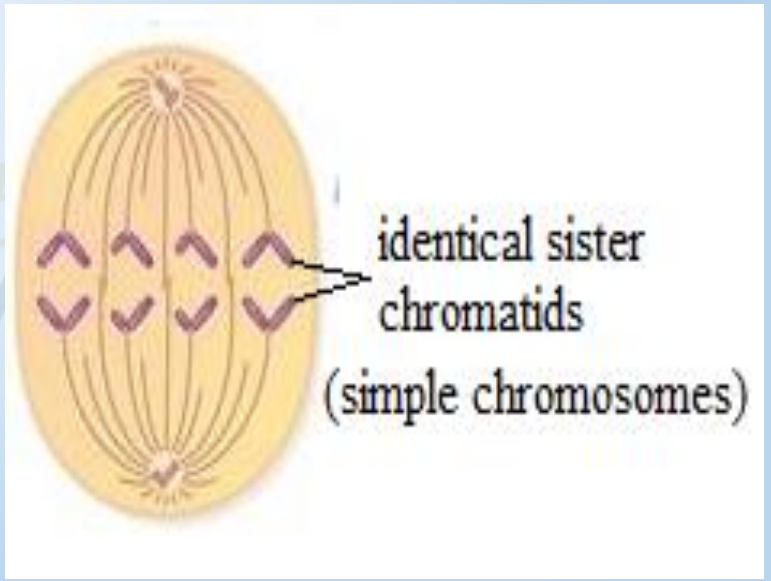
2. Metaphase: 46 chr [Condensed] Each of 2 chromatids

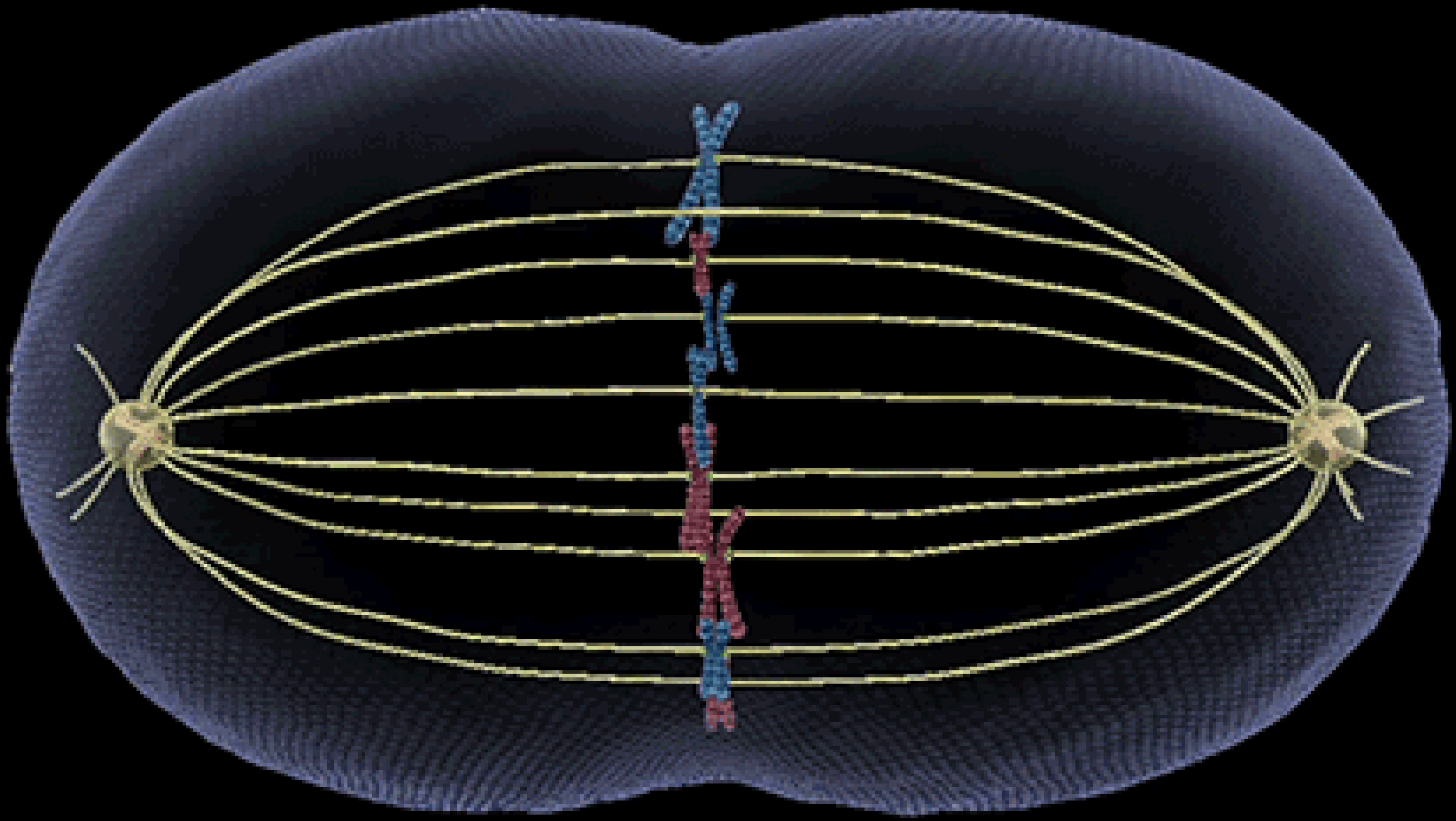
- The chromosomes (each with two chromatids) move to the center of the cell and align along the equator, forming the equatorial plate.



3. Anaphase: two Equal sets, each contains 46 chr [Condensed] Each of 1 chromatid

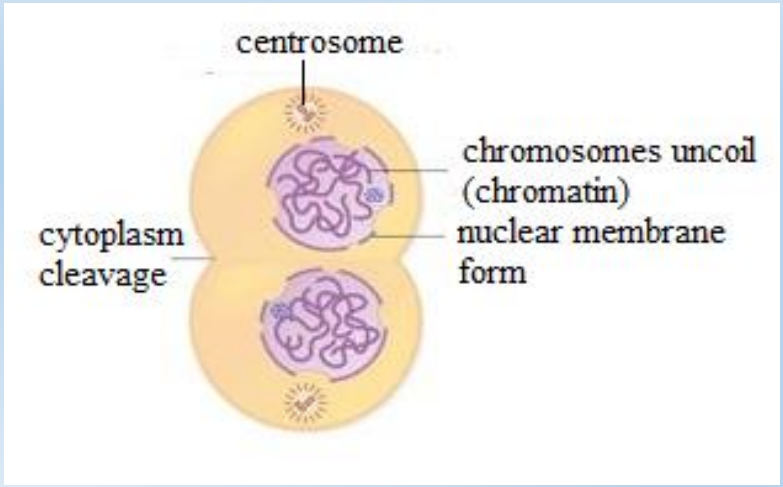
- The two chromatids of each chromosome separate as the centromere divides.
- The chromatids move to opposite poles of the cell — this process is called **polar ascension**.
- Two identical sets of chromosomes, each with one chromatid (simple chromosomes), are formed.





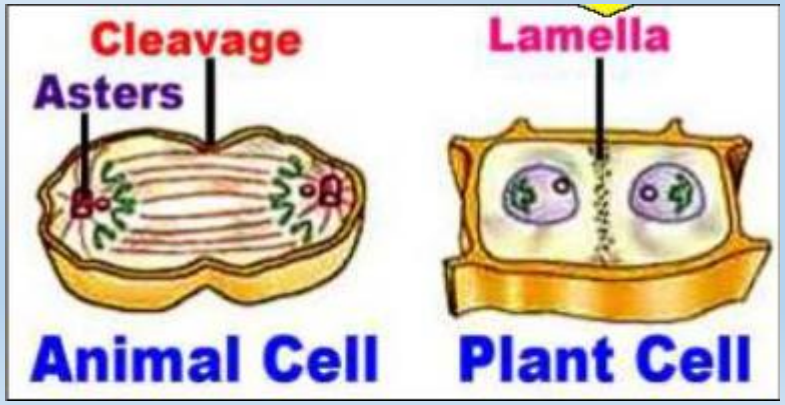
4. Telophase: two Equal sets, each contains 46 chr Each of 1 chromatid

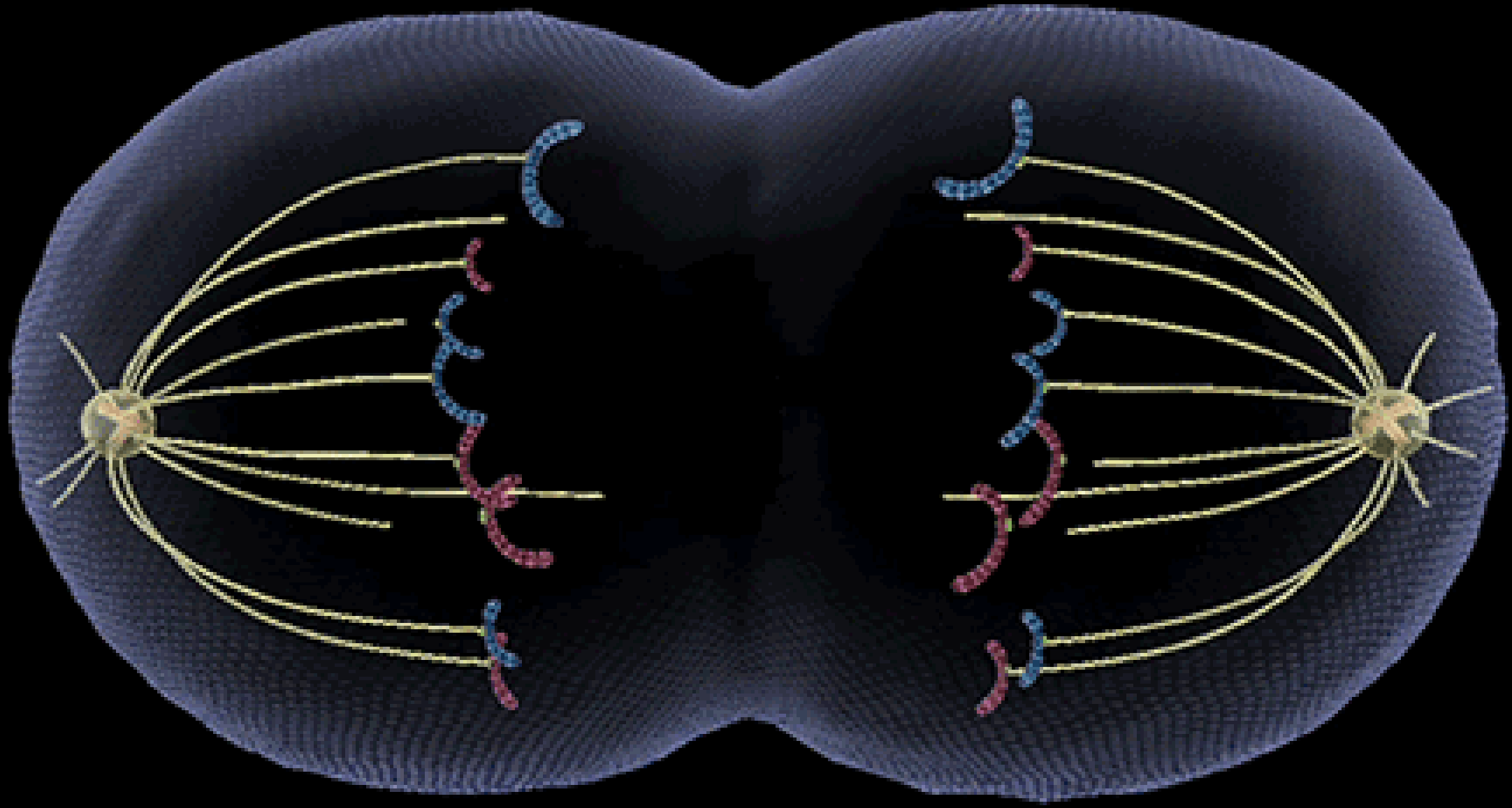
- The chromosomes uncoil and return to their chromatin form
- The asters transform back into centrosomes.
- The spindle fibers disappear.
- New nuclear membranes form around each set of chromosomes.
- The cytoplasm of the cell is cleaved in half, resulting in two daughter cells that enter interphase.
- The two daughter cells are identical to each other and to the mother cell: they have the same number of chromosomes and carry the same genetic information.



Remark:

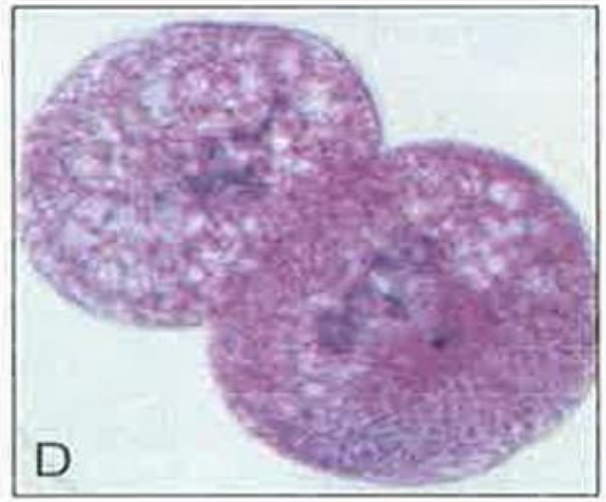
- During mitosis, both the nucleus and cytoplasm divide.
- Asters are absent in plant cells as plant cells do not have centrosomes.





1 The Process of Mitosis

a Mother cell in interphase

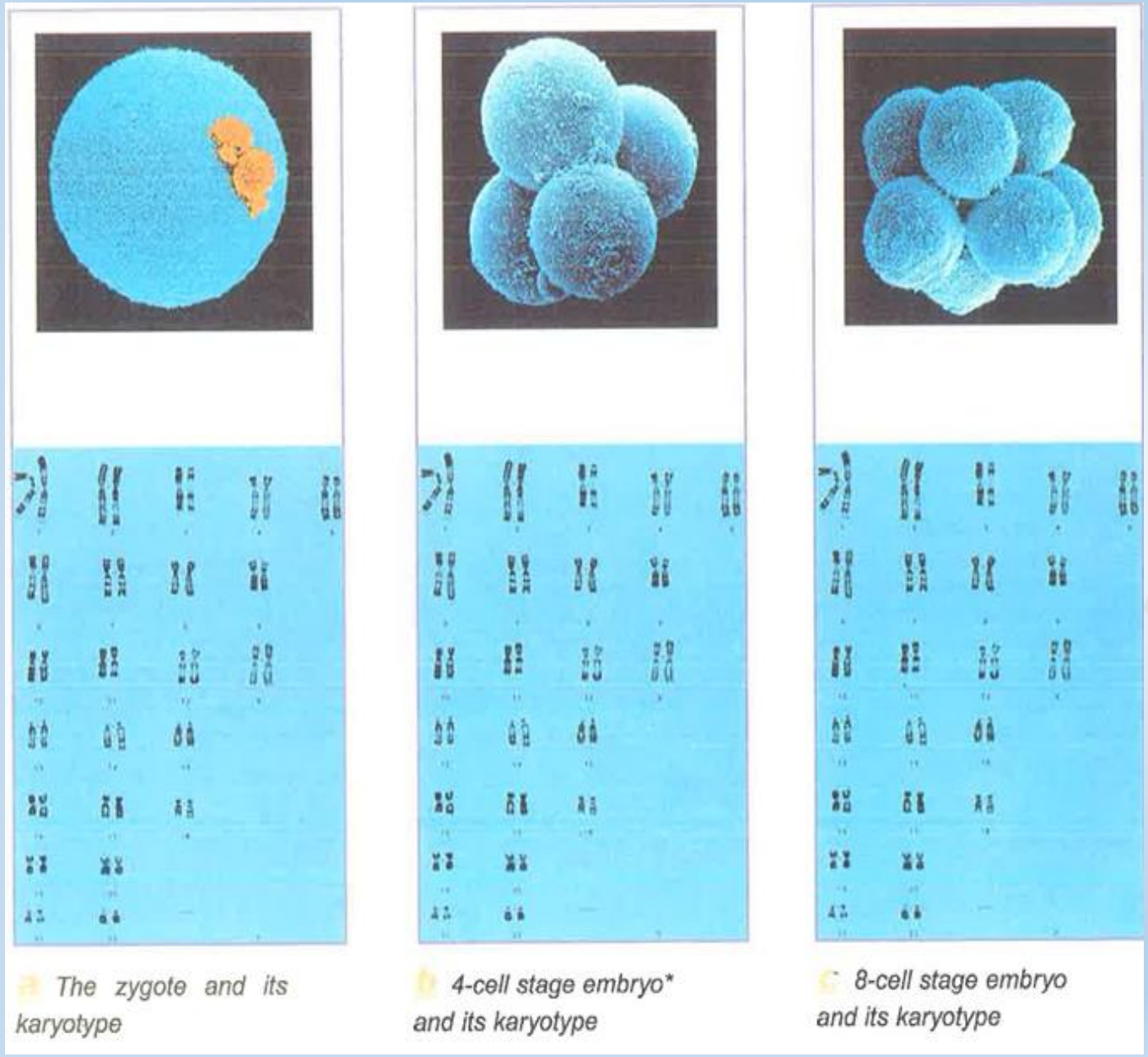


b The four phases of mitosis of an animal cell

Activity 2: Conformed Reproduction of Chromosomes

- By undergoing successive divisions, the zygote forms all the cells of an organism.
- During these divisions, there is reproduction of identical copies of chromosomes.
- Do the cells of the body carry the same karyotype as the zygote?
- How are chromosomes reproduced?

❖ Comparison and Analysis of Karyotypes



a The zygote and its karyotype

b 4-cell stage embryo* and its karyotype

c 8-cell stage embryo and its karyotype

- The **karyotypes** of a **zygote**, **4-cell embryo**, and **8-cell embryo** are **identical**.

- **The zygote and all resulting embryonic cells (4-cell, 8-cell, etc.) have the same karyotype: same number, size, and shape of chromosomes, carrying the same genetic information.**

- **Why?**

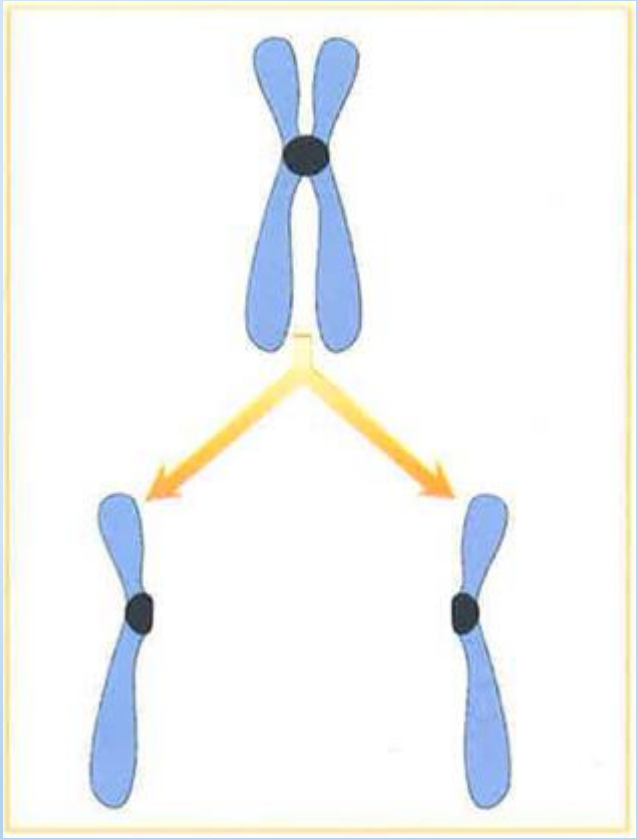
• Each cell division is **mitotic**, meaning:
• **No change in chromosome number** (still 2n = 46 in humans).
• **No change in genetic content**—each new cell is genetically identical to the parent.
•Therefore, all early embryonic cells **inherit the same karyotype** as the original zygote.

❖ Duplication of chromosomes

- Conformed reproduction of chromosomes takes place during interphase, that is the stage between two cellular divisions.
- During this period, the chromosomal material doubles and leads to the formation of chromosomes having two chromatids that remain attached by the centromere.

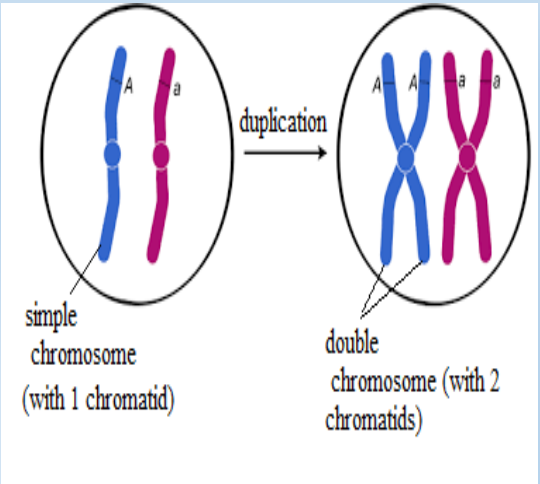
❑ **Interphase** is a phase between 2 mitoses.

- It is a period of cell growth during which the chromosomes are not visible in the nucleus (they are in the form of chromatin).
- The cell spends the majority of its life cycle in interphase.

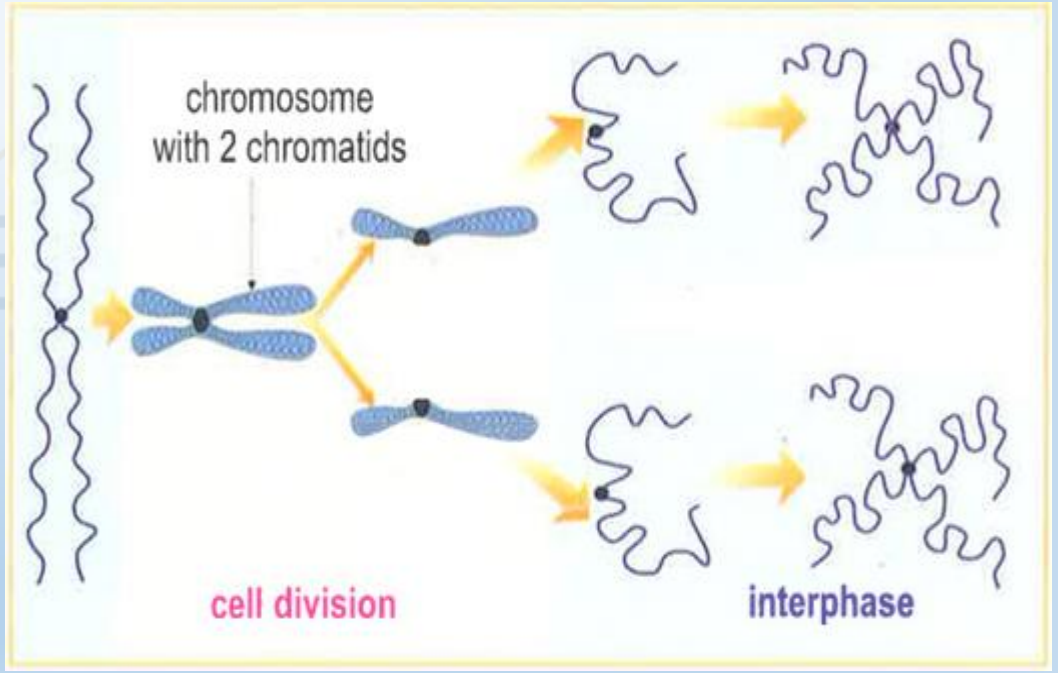


Behavior of chromosomes during cellular division

- During this period, the cell **duplicates** (doubles) its chromosomal material, leading to the formation of chromosomes with 2 chromatids (double chromosomes) that are attached by the centromere: **conformed reproduction.**

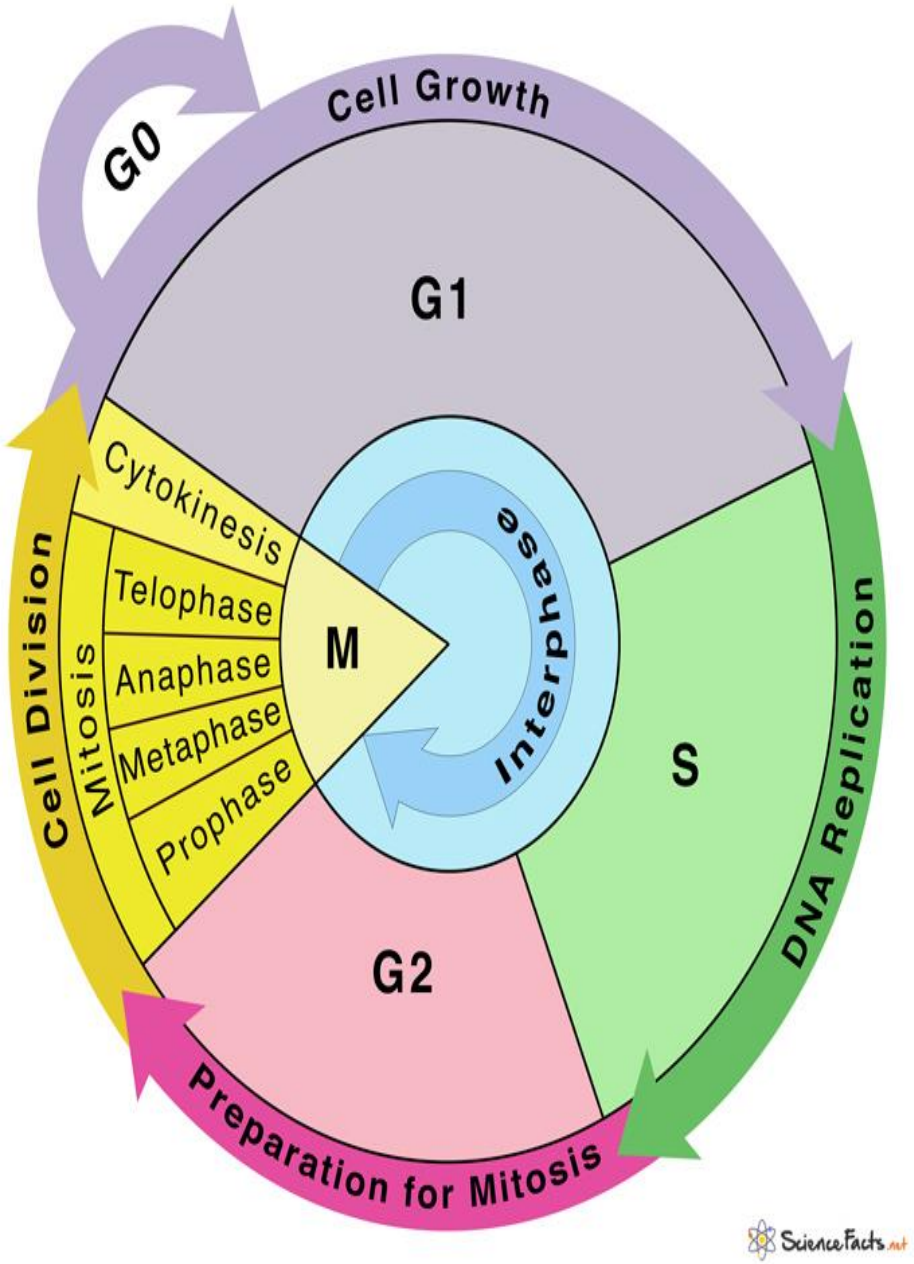


- **Duplication:** doubling of the chromosomal material: each simple chromosome produces an identical copy of itself.



Mode of conformed reproduction of chromosomes

Cell Cycle


G0
Cell Growth
G1
Cytokinesis
Telophase
Anaphase
Metaphase
Prophase
M
Mitosis
Cell Division
Interphase
S
DNA Replication
G2
Preparation for Mitosis
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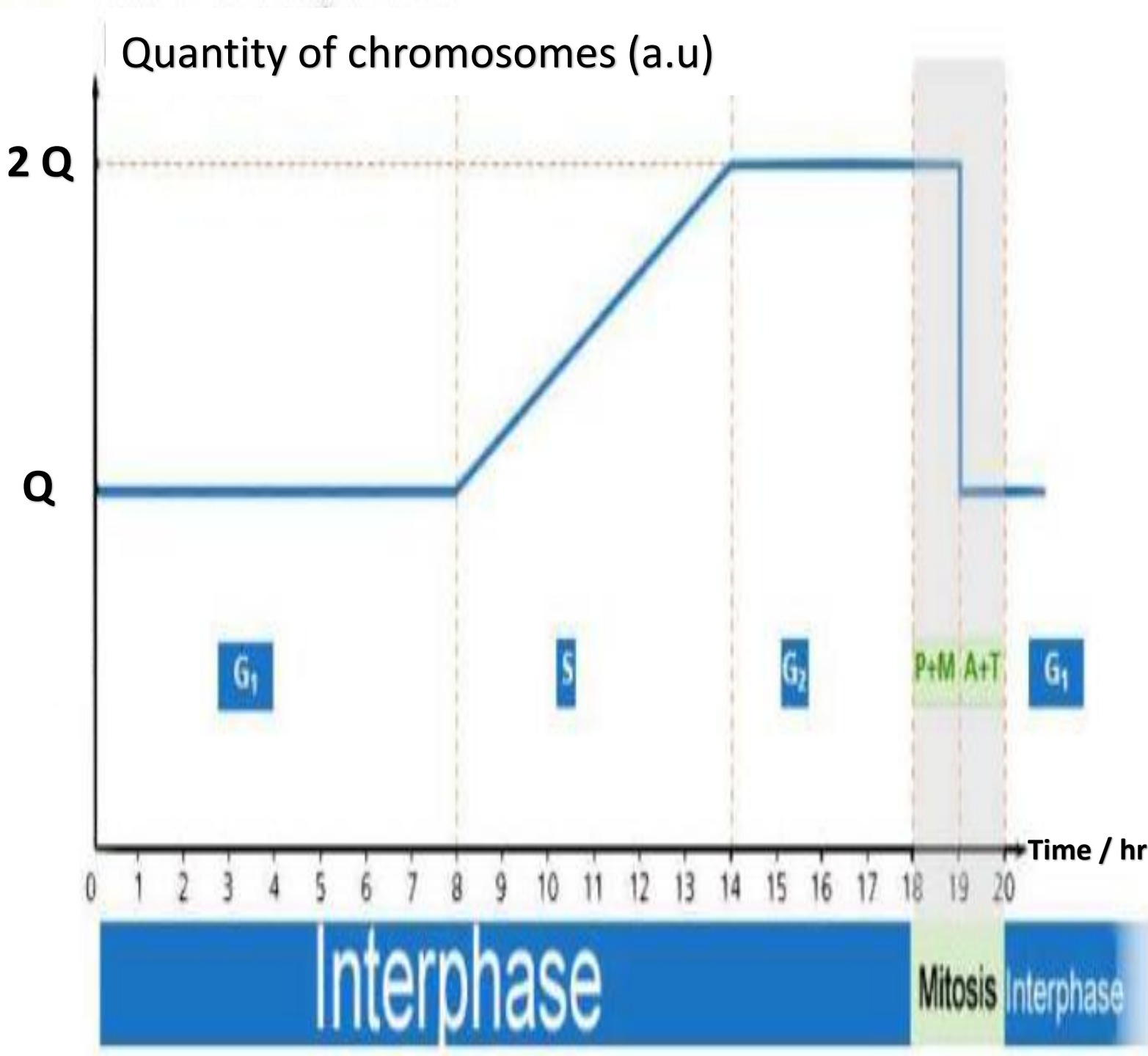
Quantity of chromosomes (a.u)
2 Q
Q
G1
S
G2
P+M
A+T
G1
Time / hr
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
Interphase
Mitosis
Interphase