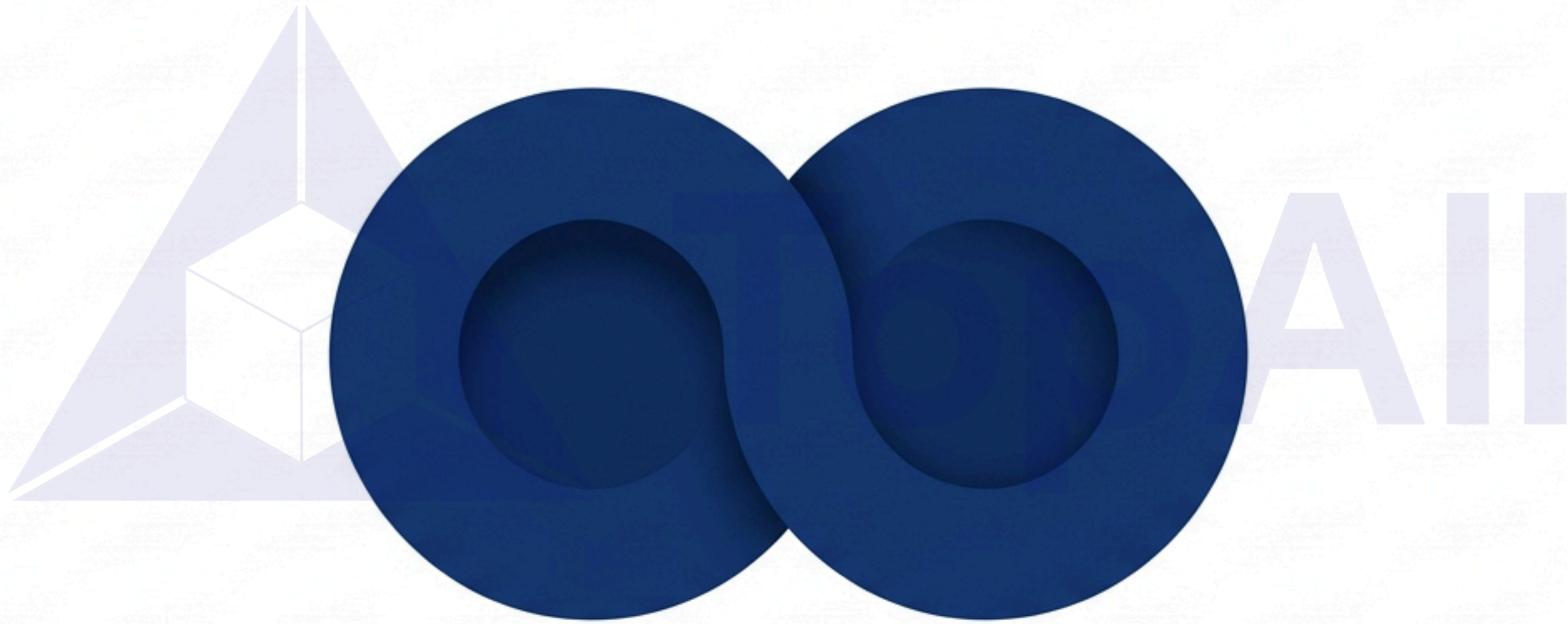


The Dramatic Division Phase

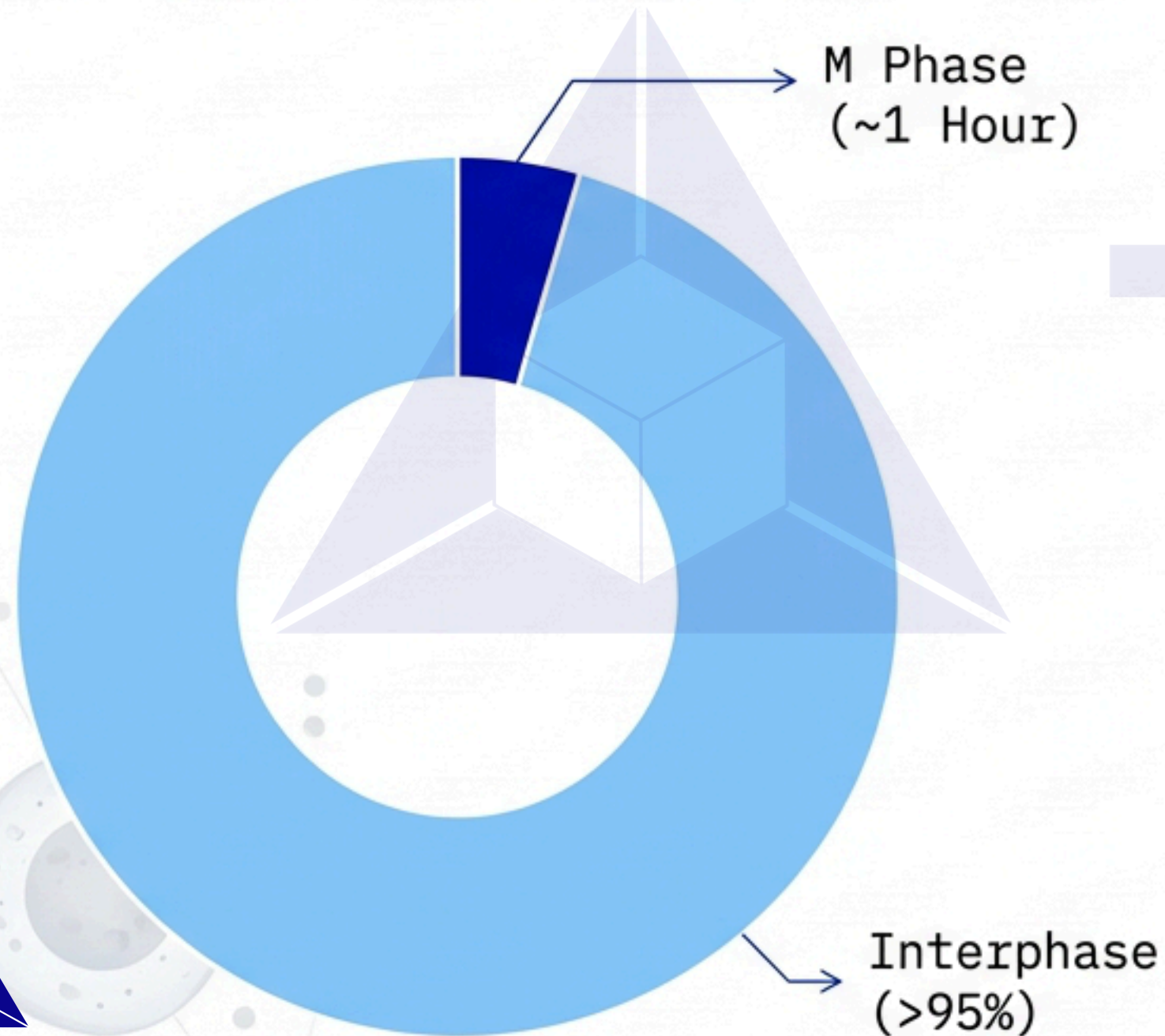
A Visual Guide to M Phase & Mitosis



Chapter 10.2 Synthesis

The Peak of the Cell Cycle

The M Phase represents the actual cell division. Though brief, it involves a major, dramatic reorganization of virtually all cellular components.



The Timeline

In an average 24-hour human cell cycle, cell division proper (M Phase) lasts for only about 1 hour. The other >95% is spent in Interphase preparation.

The Components

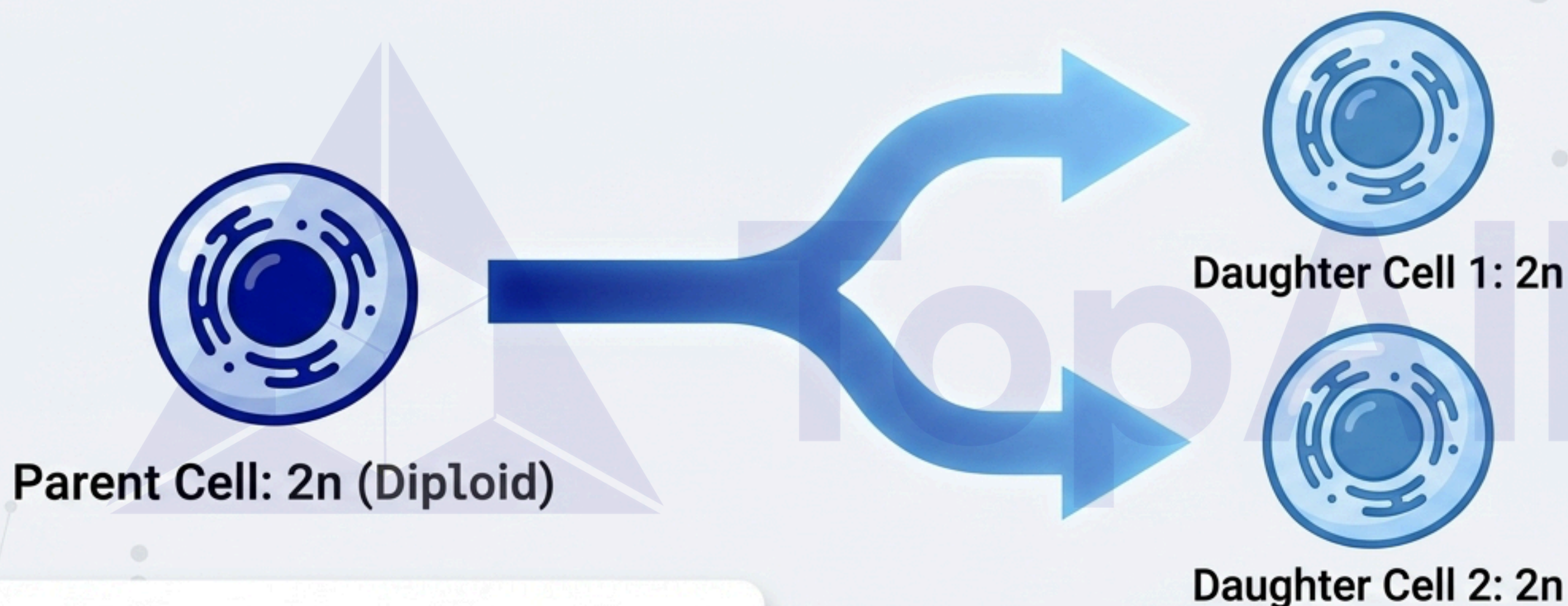
M Phase consists of two distinct but continuous processes:

1. **Karyokinesis:** Nuclear division (separation of daughter chromosomes)
2. **Cytokinesis:** Cytoplasmic division

Summary: M Phase is the brief, highly coordinated climax of the cell cycle where the duplicated genome is physically separated.

Mitosis as Equational Division

Mitosis is usually restricted to diploid cells. Its defining characteristic is the perfect conservation of the genetic code.



Why Equational?

Because the number of chromosomes in the parent and progeny cells is exactly the same. The genetic complement remains identical.

Significance: Restores the nucleo-cytoplasmic ratio, facilitates continuous growth in plants (meristems), and enables cell repair/replacement in animals (e.g., epidermis, gut lining, blood cells).

Karyokinesis: The 4-Act Play

Karyokinesis is the complex process of nuclear division. While scientists divide it into four stages for convenience, it is a continuous, fluid progression.



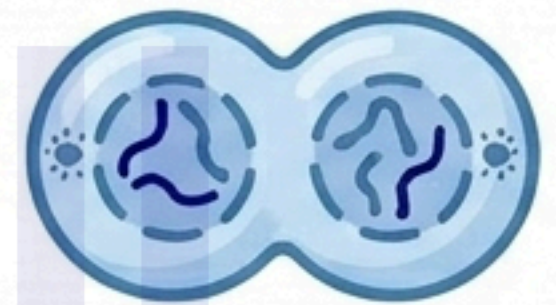
PROPHASE
The Setup



METAPHASE
The Alignment



ANAPHASE
The Separation



TELOPHASE
The Resolution

Important Distinction: Cell division is a progressive process. Very clear-cut boundary lines cannot be drawn between these various stages in a living cell.



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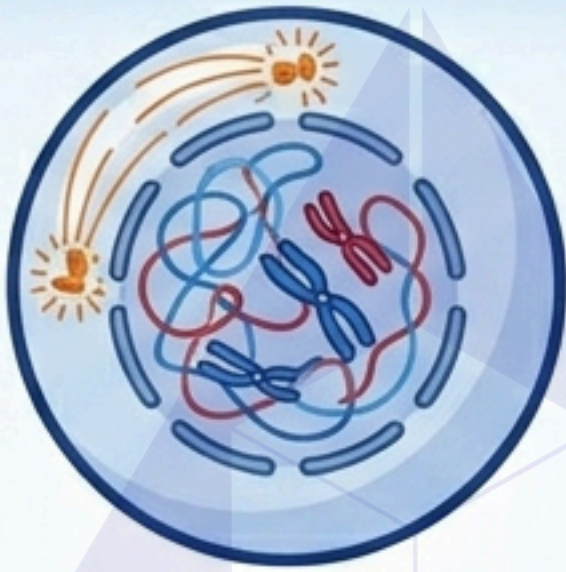
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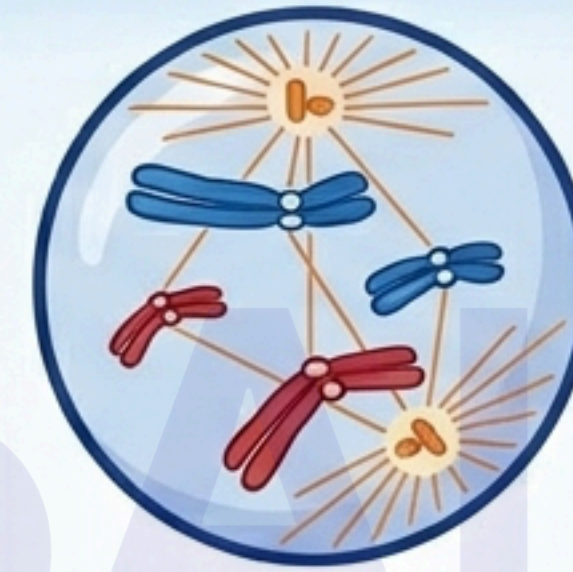
Act 1: Prophase

Following DNA duplication in S and G2 phases, intertwined genetic material begins to take structure.



Early Prophase

- **Chromatin Condensation:** Untangled DNA begins to pack tightly into compact mitotic chromosomes.
- **Centrosome Migration:** Duplicated centrosomes begin moving toward opposite poles of the cell.



Late Prophase

- **Mitotic Apparatus Forms:** Centrosomes radiate microtubules called asters. Two asters + spindle fibers = mitotic apparatus.
- **Organelle Disassembly:** The nucleolus, Golgi complexes, endoplasmic reticulum, and nuclear envelope disappear.

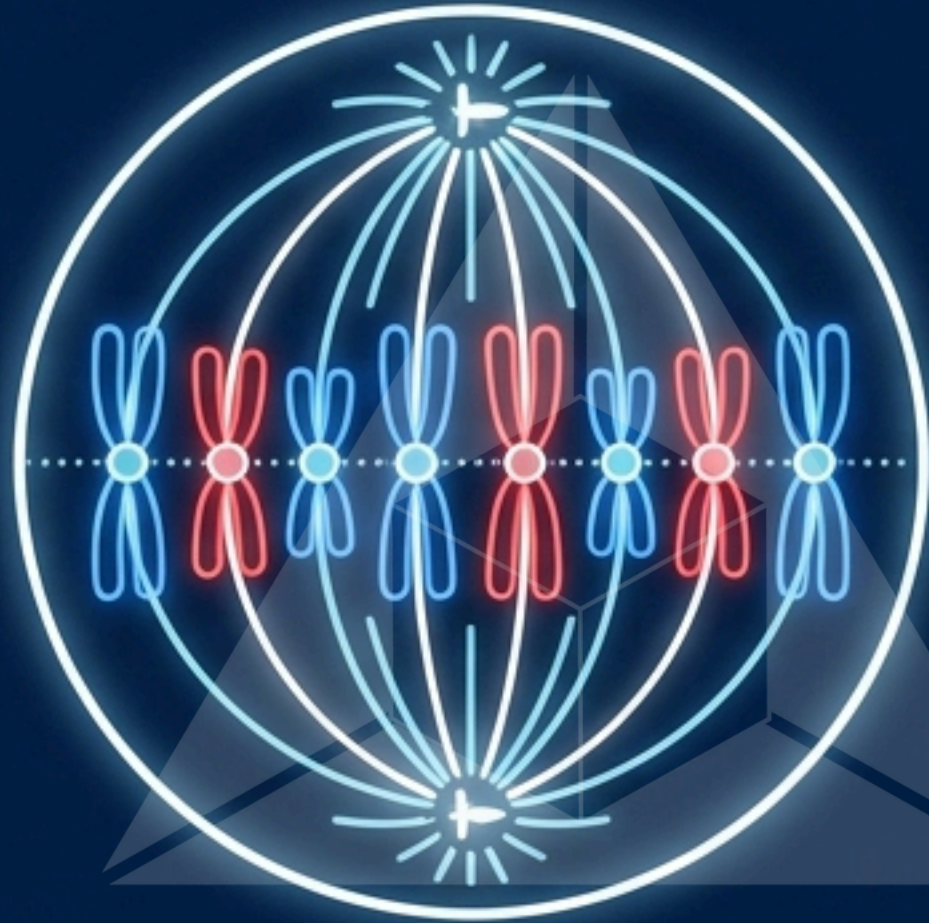
LEGULARIT

CHROMATID

Chromosomes are now seen composed of two chromatids attached together at the centromere.

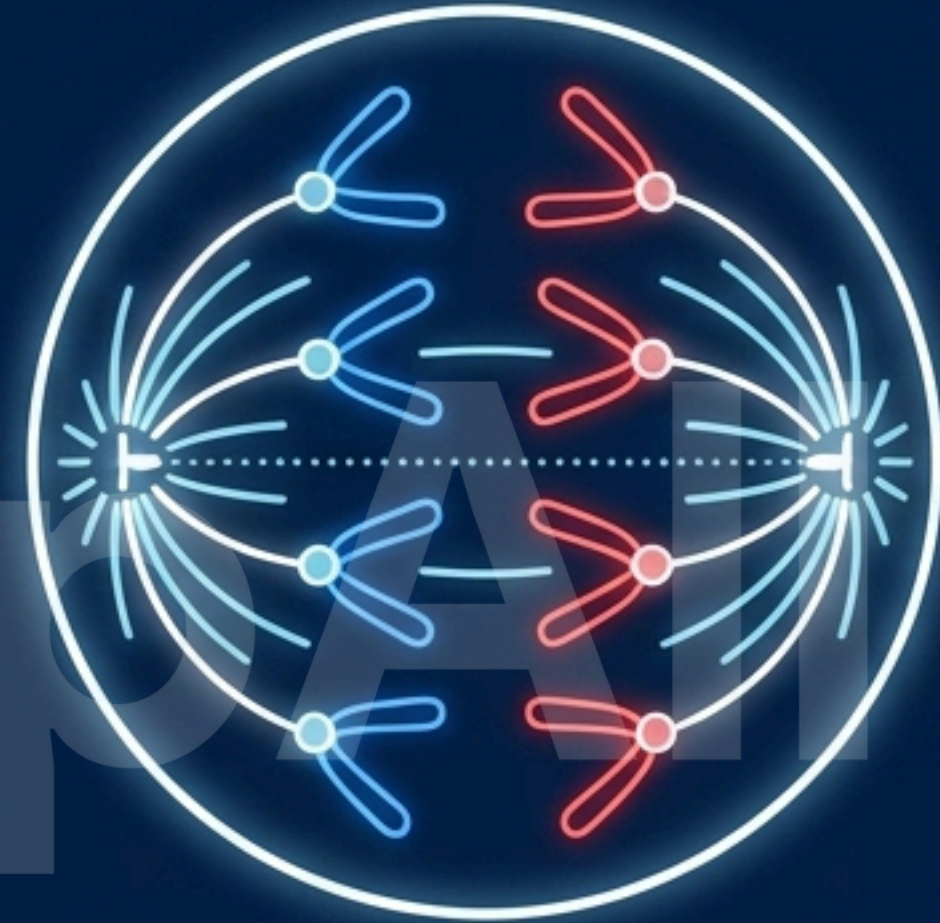
Acts 2 & 3: Metaphase and Anaphase

Metaphase: The Alignment



- **Nuclear Envelope Gone:** Chromosomes spread freely through the cytoplasm.
- **Maximal Condensation:** Morphology is most easily studied here.
- **KINETOCHORES:** Small disc-shaped structures on centromeres attach to spindle fibers.
- **Metaphase Plate:** Chromosomes align precisely at the equator, connected to opposite poles.

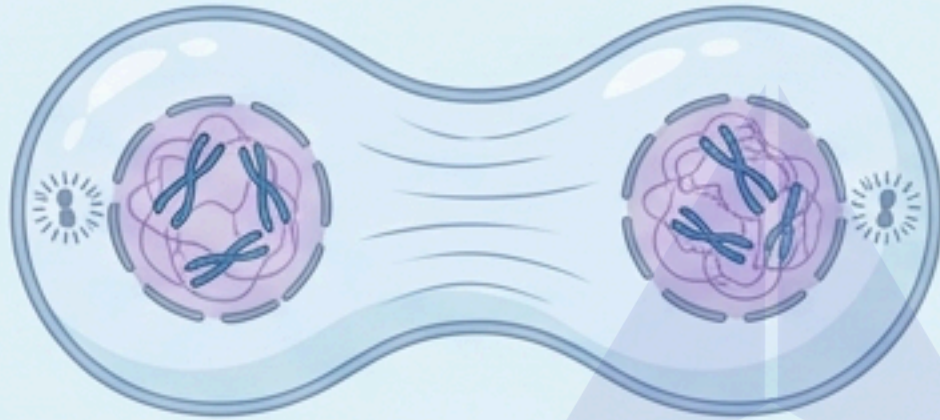
Anaphase: The Separation



- **Simultaneous Split:** Centromeres split instantly; chromatids separate.
- **Migration:** Now called daughter chromosomes, they migrate to opposite poles.
- **Orientation:** Centromeres lead the way toward the poles, with the chromosome arms trailing behind (forming V/J shapes).

Act 4 & Epilogue: Telophase and Cytokinesis

Telophase



- **Decondensation:** Chromosomes reach poles and lose their individuality, reverting to chromatin.
- **Reassembly:** Nuclear envelope develops around clusters. Nucleolus, Golgi, and ER reform.

Animal Cells

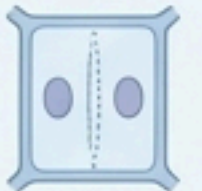
Achieved via a cleavage furrow in the plasma membrane.



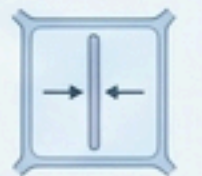
Furrow deepens from the outside-in, dividing the cytoplasm.

Plant Cells

Furrowing impossible due to rigid cell walls.



Cell plate (middle lamella precursor) grows from the center outward.



Failed Cytokinesis: If karyokinesis occurs without cytokinesis, it results in a multinucleate condition called a syncytium (e.g., liquid endosperm in coconut).

The Full Mitosis Flow

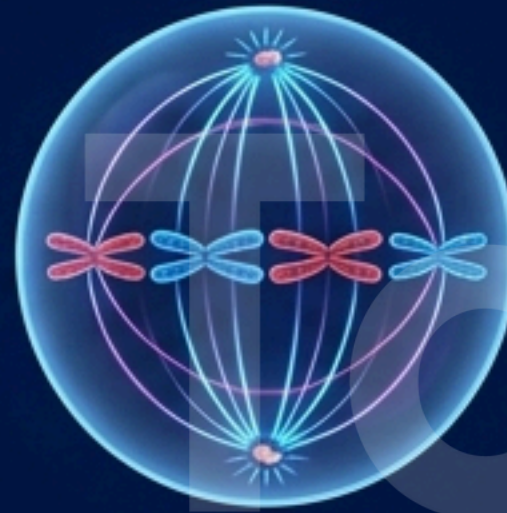
From intact nucleus to divided daughter cells.



Early
Prophase



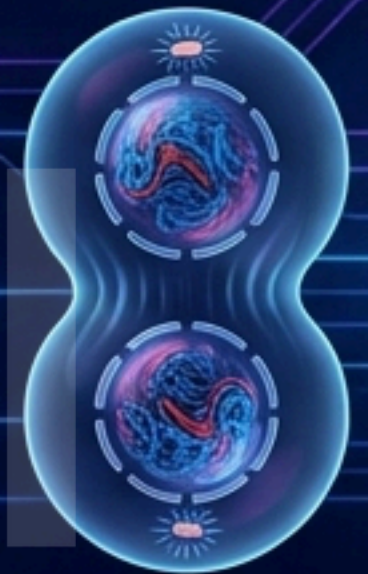
Late
Prophase



Metaphase



Anaphase



Telophase /
Cytokinesis

Final Result: One continuous biological event ensuring the exact preservation of life's genetic blueprint.



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