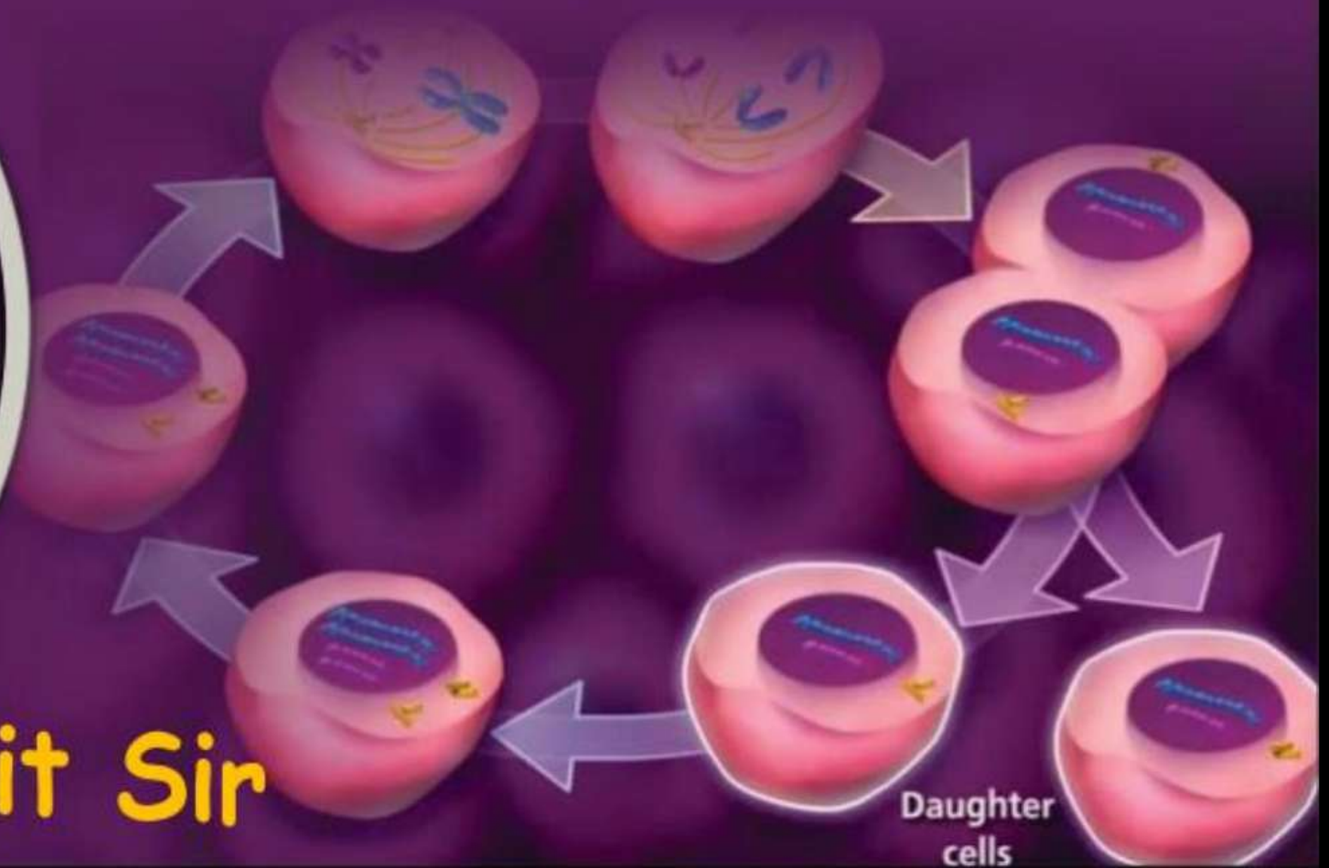
ARJUNA NEET BATCH

CELL CYCLE AND CELL DIVISION

By : Biswajit Sir



Objective of today's class

MECHANISM OF MITOSIS

MECHANISM OF MITOSIS:-

- Cell division is a progressive (continuous) process.
- Very clear cut lines between phases can't be drawn.
- For convenience, we divide cell cycle into various phases

Karyokinesis during mitosis

- Newly formed DNAs in S phase and G2 phase are not distinct but intertwined
- Includes prophase, metaphase, anaphase, telophase

A. Prophase

• Can be divided in 3 subphases like

1. Early prophase
2. Middle prophase
3. Late prophase

Early prophase

- Chromatin (chromosomal material)

Condensation. By condesin

↓

Chromosome

↓

1. Longest, thinnest
2. Chromatids are not visible
3. Telomeres are not visible
4. Hence chromosomes appear like ball of wool

Hence early prophase is called Spireme stage

Note :-

Condensation of chromatin starts in early prophase and completes by metaphase

- **Daughter centrosomes start to move away from each other**

- **Formation of astral rays and aster**
  (made of MT)
  centrosome + astral rays

- **Cell division in**
  Animal cells → amphiastral
  Plant cells → Anastral

Middle prophase

- Further condensation of chromosomes

↓

Chromatids become visible

- Each chromosome appears to consists of two chromatids which are held at centromere by cohesion protein
- Nuclear membrane starts disappearing

Late prophase

- Nuclear membrane, nucleolus, ER, GB completely disappear
- Daughter centrosomes (asters) reach opposite poles
- Spindle fibre formation starts
- Mitotic apparatus spindle fibres + 2 asters

B. Metaphase

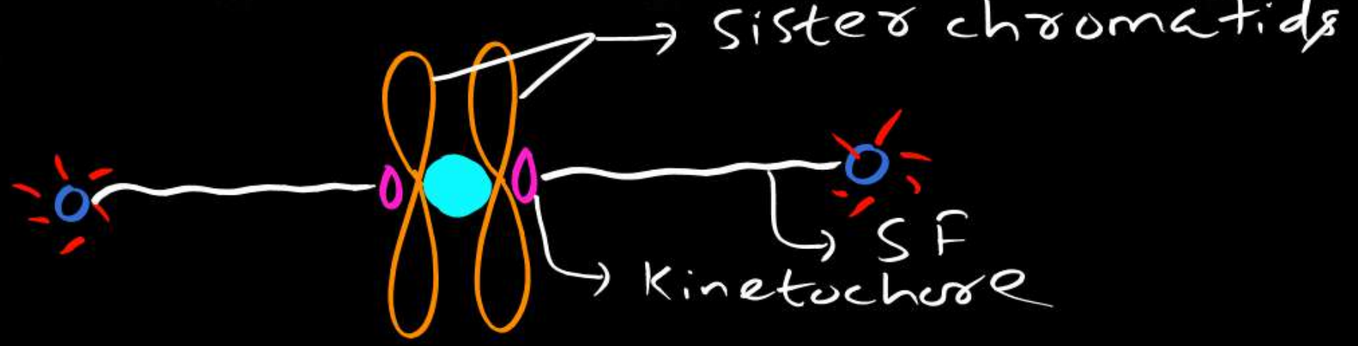
- Complete disappearance of Nuclear membrane marks the beginning of metaphase
- By this stage condensation of chromosomes complete
- Chromosomes are thickest and shortest
- Chromosomes are easiest to visualize

Best phase to study chromosome

↓

number, size, structure, (shape)

- Spindle fibres bind to the kinetochore (centromere)
- Each chromosome gets bound to spindle fibres coming from both poles.



- The spindle fibres bring chromosomes at equator of spindle by the process called congression
- The plane of alignment of all chromosomes is called equatorial plate or metaphasic plate

Note:-

In metaphasic plate the arms of chromosomes are variously oriented, and larger chromosomes lie at centre while smaller chromosomes at periphery

B. Anaphase

MPF (Maturation promoting factor)

↓ Activates

APC (anaphase promoting complex)

↓ Inactivates

Anaphase inhibitors (ex- securin)

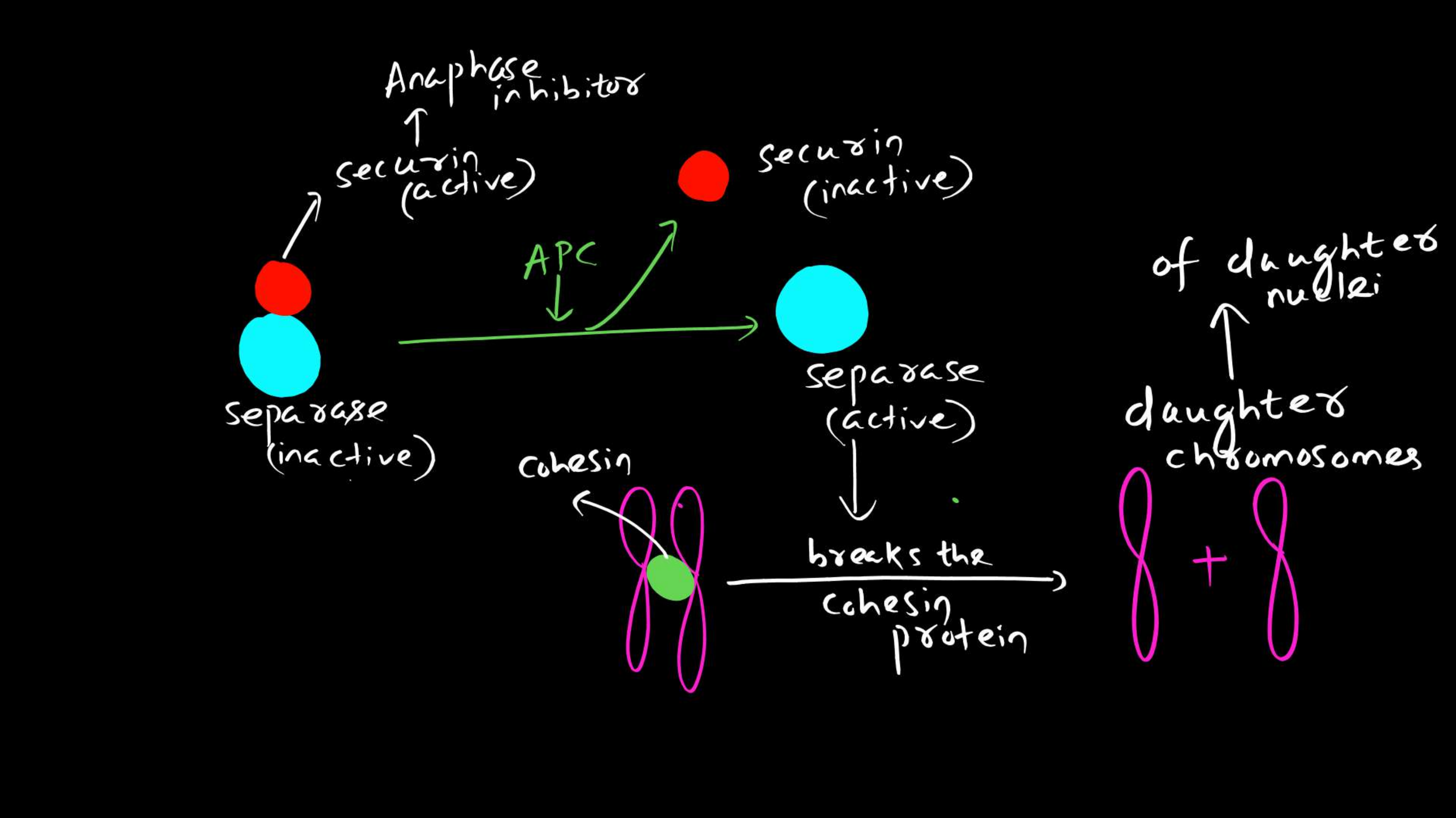
↓

Onset of anaphase

↓

Splitting of centromere and break down of cohesion

Sister chromatids become free) & are now called daughter chromosomes


Anaphase inhibitor
securin (active)
securin (inactive)
APC
separase (inactive)
separase (active)
of daughter nuclei
daughter chromosomes
cohesin
breaks the cohesin protein
+

- The daughter chromosomes move towards the opposite poles due to

C. Pulling- by chromosomal spindle fibres

D. Pushing - by interzonal spindle fibres

- At the end of anaphase the chromosomal groups (chromatids) reach the opposite poles

C. Telophase

- Reverse of prophase

Events:-

1. Reappearance of nuclear membrane, nucleolus, ER, GB
2. disappearance of spindle fibres, astral rays
3. Decondensation of chromosomes to form chromatins

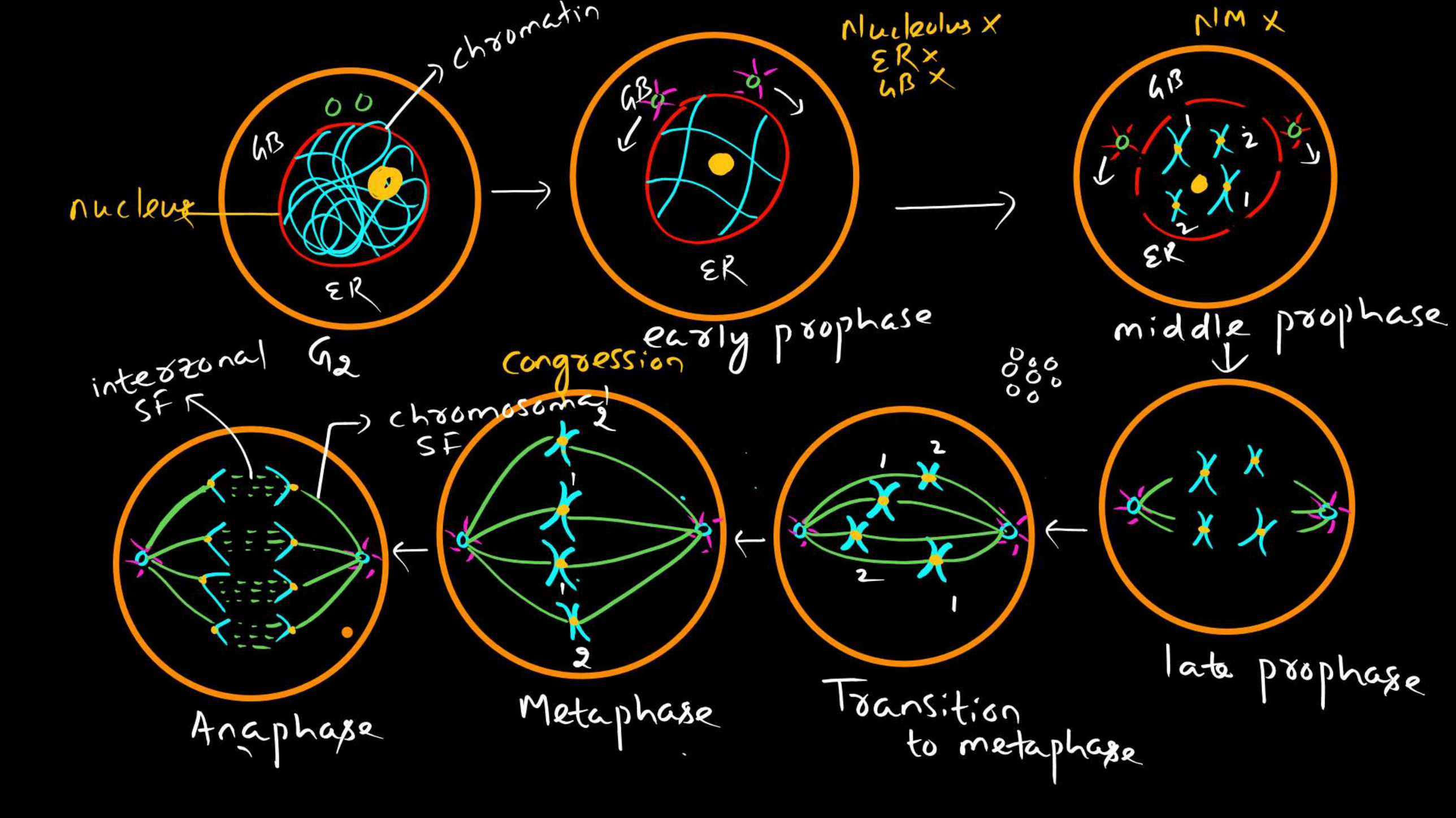
↓ ∴

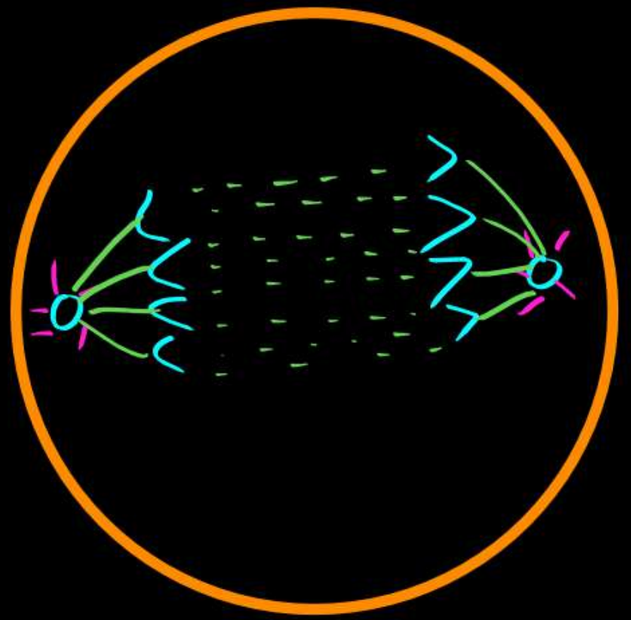
chromosomes lose their identity

Note
In plant cells interzonal SF persists

✳ **Sequence of some events:-**

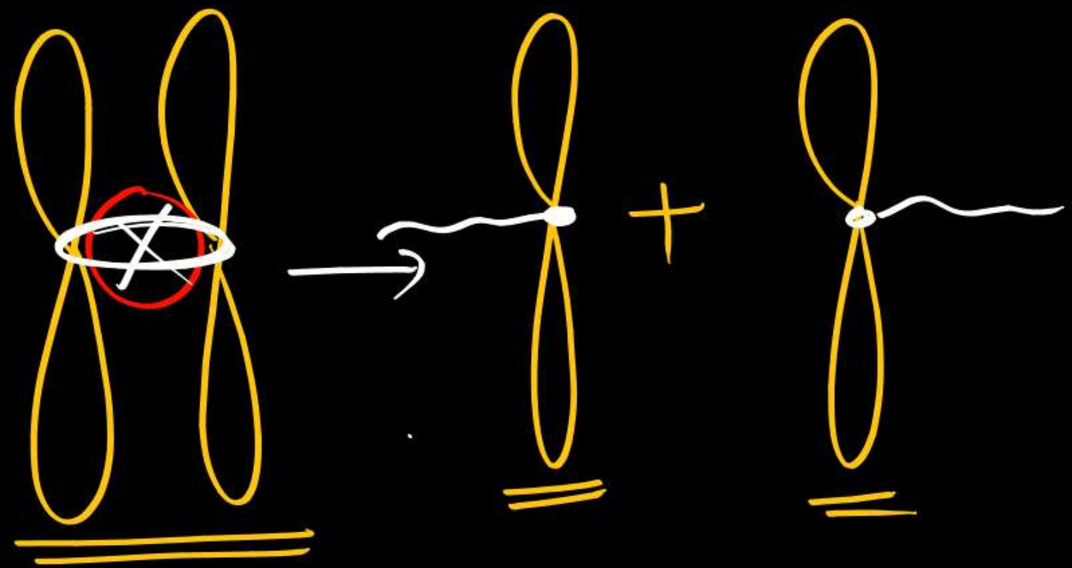
a. Formation of phragmoplast (in anaphase)
b. Reformation of nuclear envelope
c. Reassembly of nuclear lamina (telophase)
d. Decondensation of chromosomes
e. transcription of genes


chromatin
nucleus
GB
ER
G2
Nucleolus X
ER X
GB X
early prophase
NM X
middle prophase
late prophase
Congression
chromosomal SF
interzonal SF
Metaphase
Anaphase
Transition to metaphase



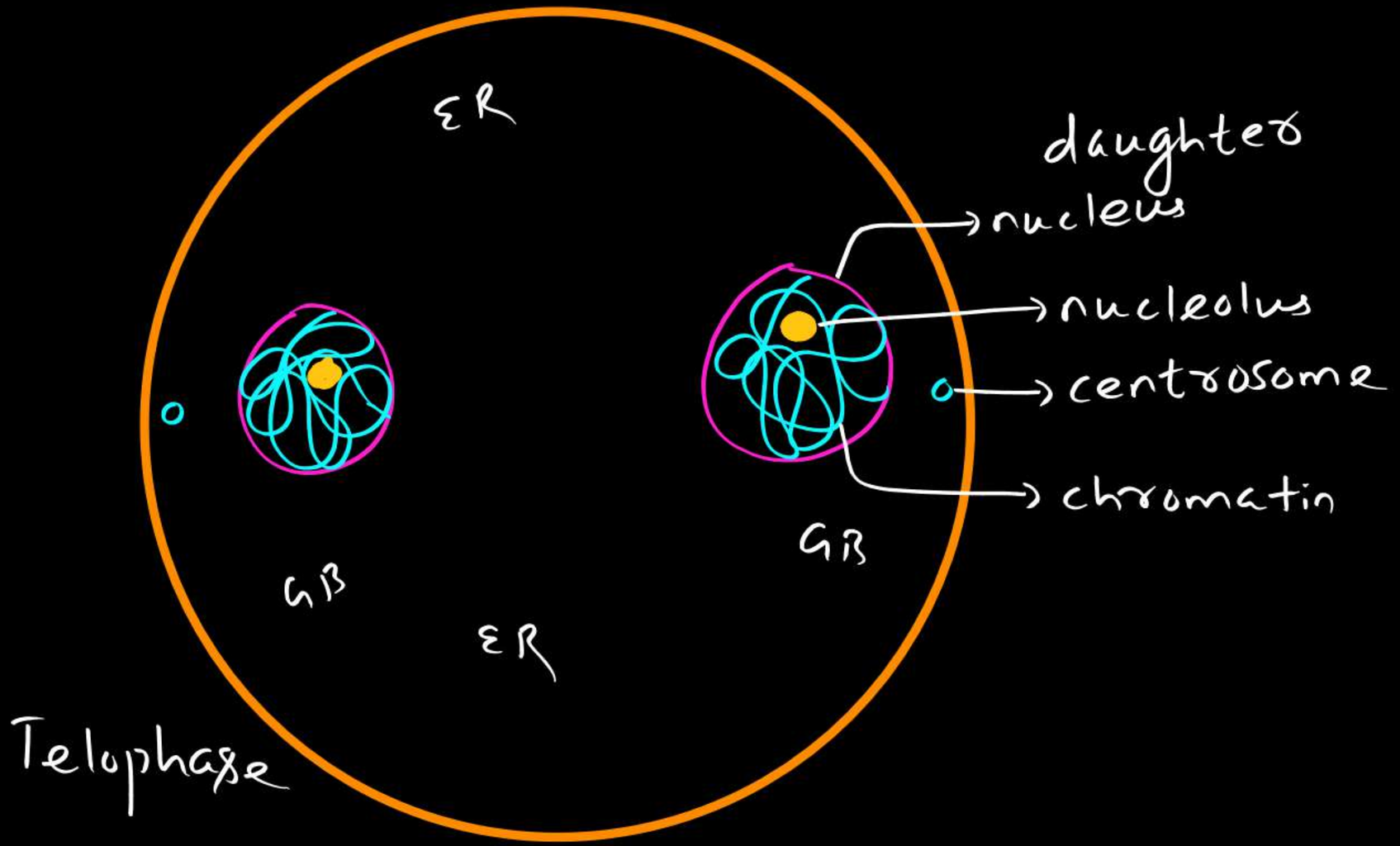
end of anaphase

clusture
group



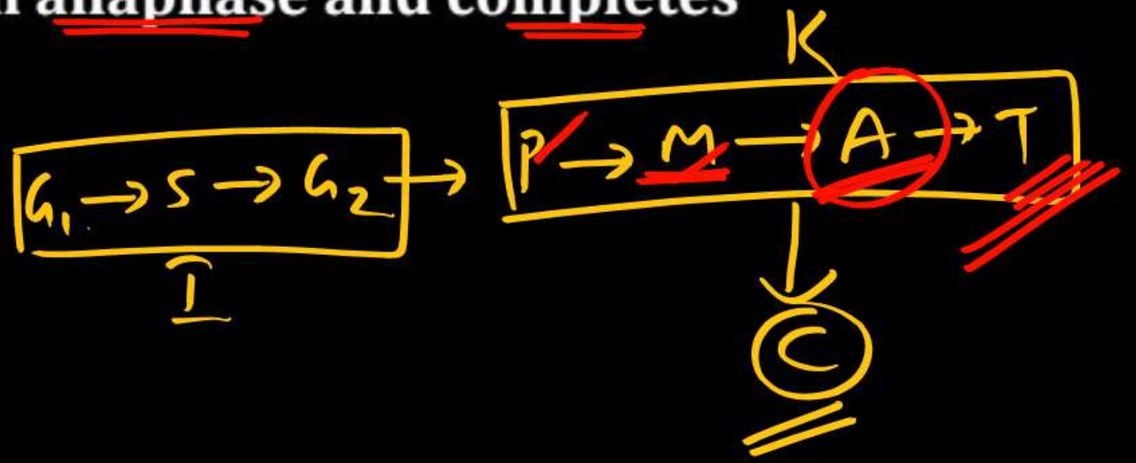
cohesin X

1x centromere → 2 centromere


ER
daughter
nucleus
nucleolus
centrosome
chromatin
GB
GB
ER
Telophase

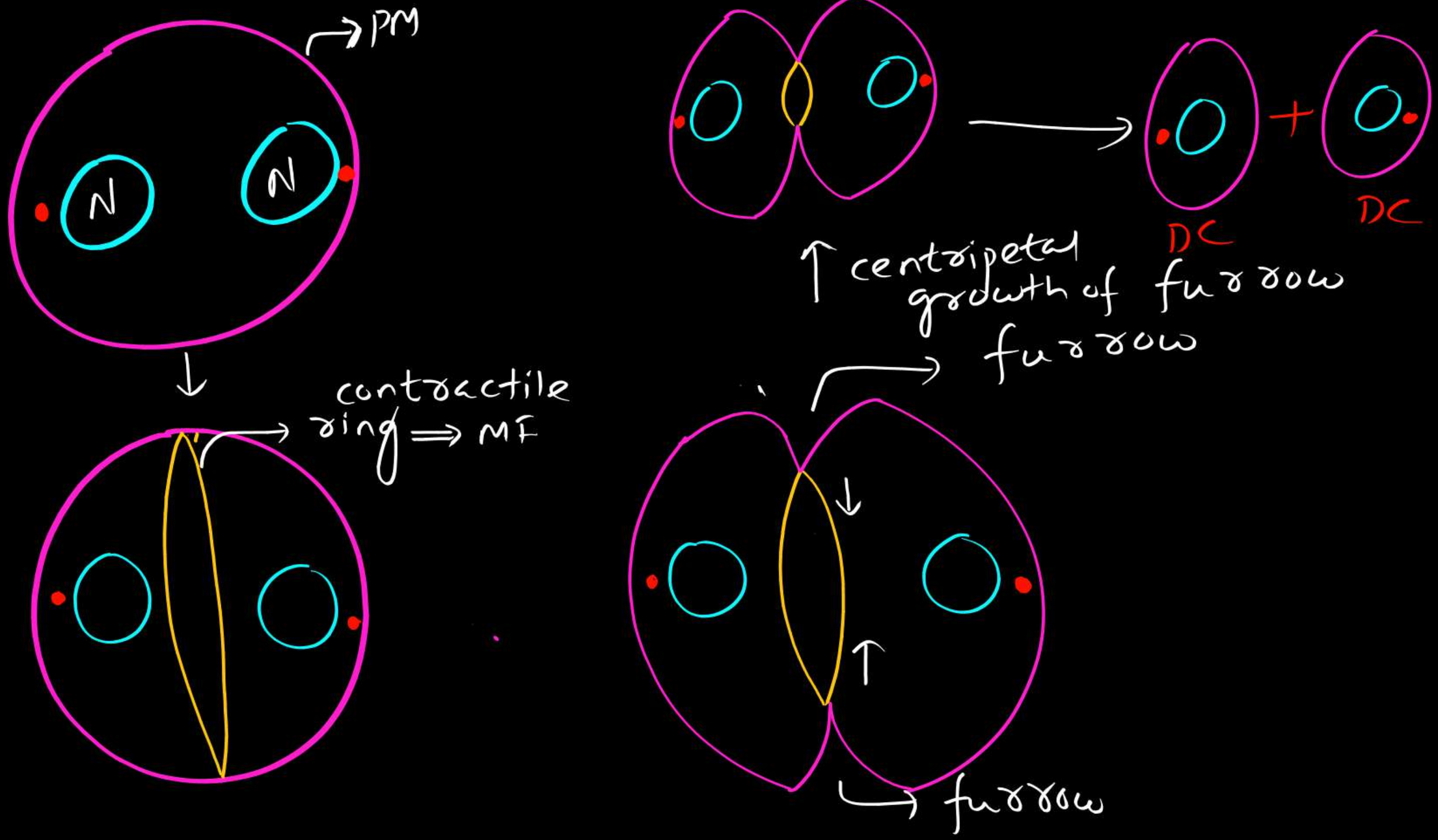
CYTOKINESIS:-

- division of cytoplasm
- Normally starts after completion of karyokinesis
- In some cases cytokinesis starts in anaphase and completes at the end of telophase
- Methods of cytokinesis



1. Furrow formation method

- Found in animals
- Microfilaments are involved
- Contractile ring is in contact with plasmamembrane
- Contractile ring contracts to form furrows which deepens with time
- Furrow grows centripetally and ultimately causes cytokinesis


PM
N
N
contractile ring ⟹ MF
DC
DC
centripetal growth of furrow
furrow
furrow

2. cell plate formation

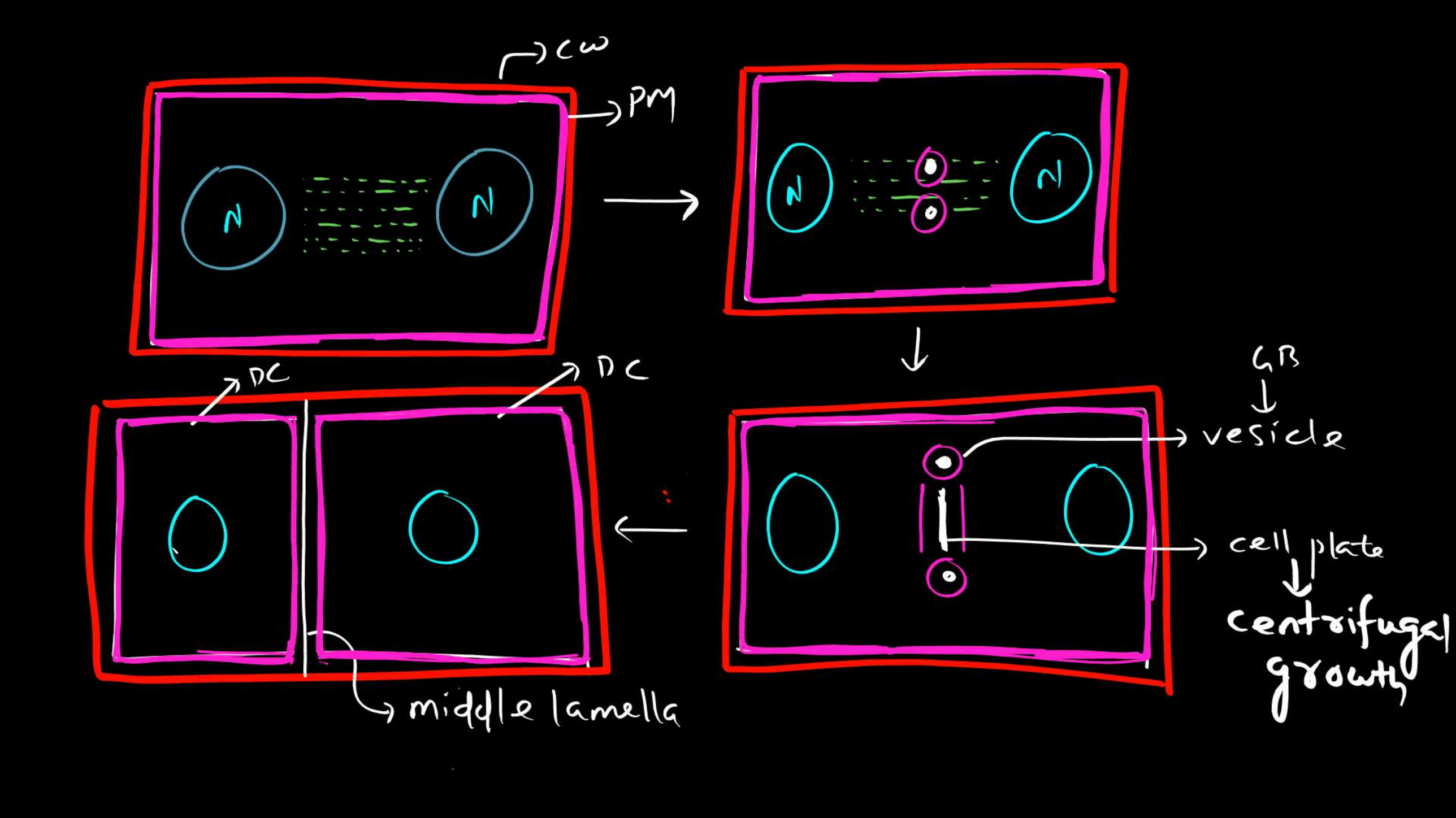
- Found in plants
- Microtubules are involved
- In plants furrow formation can't take place due to presence of rigid cell wall

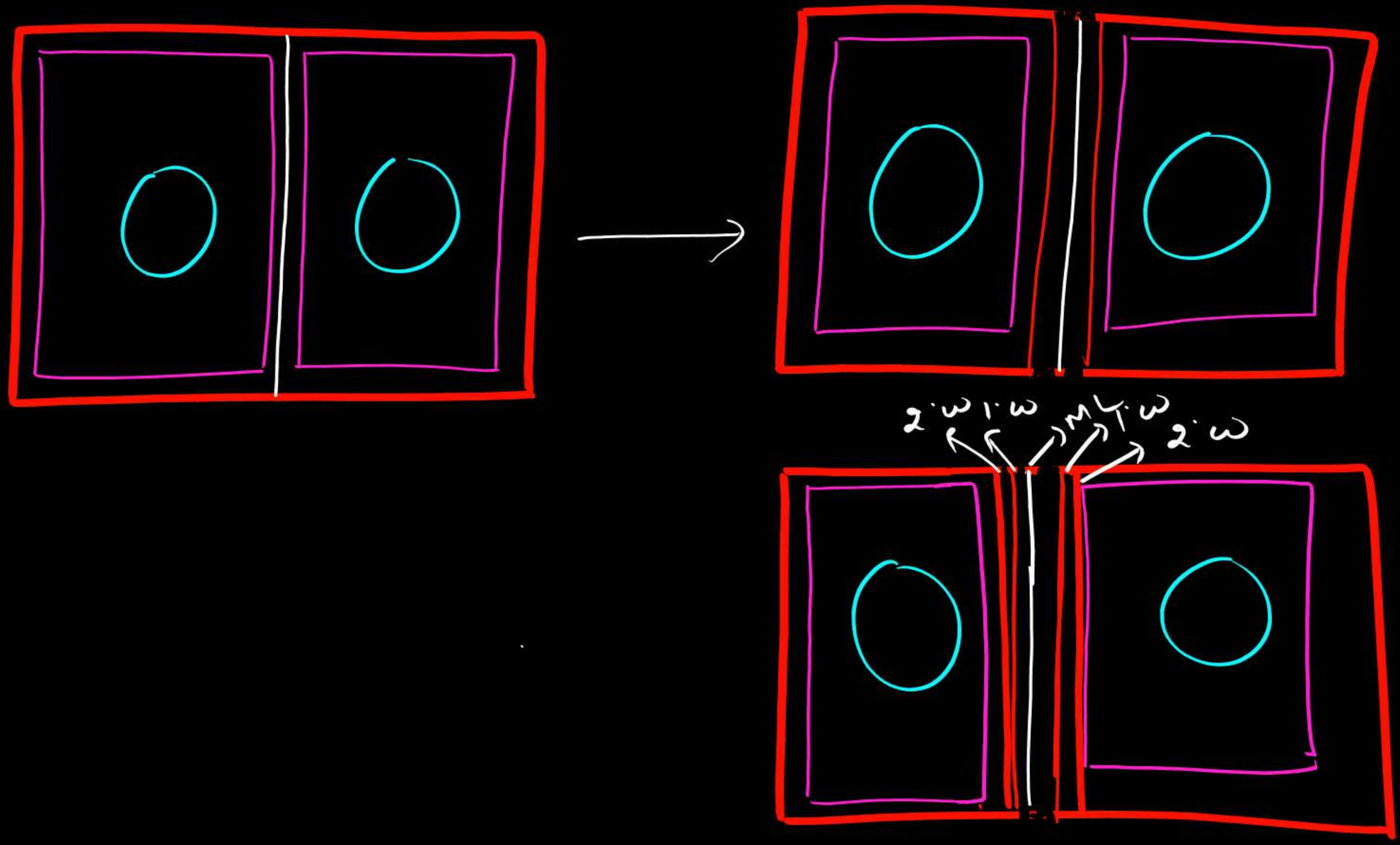
- Cell plate is formed by fusion of golgian vesicles
- Cell plate

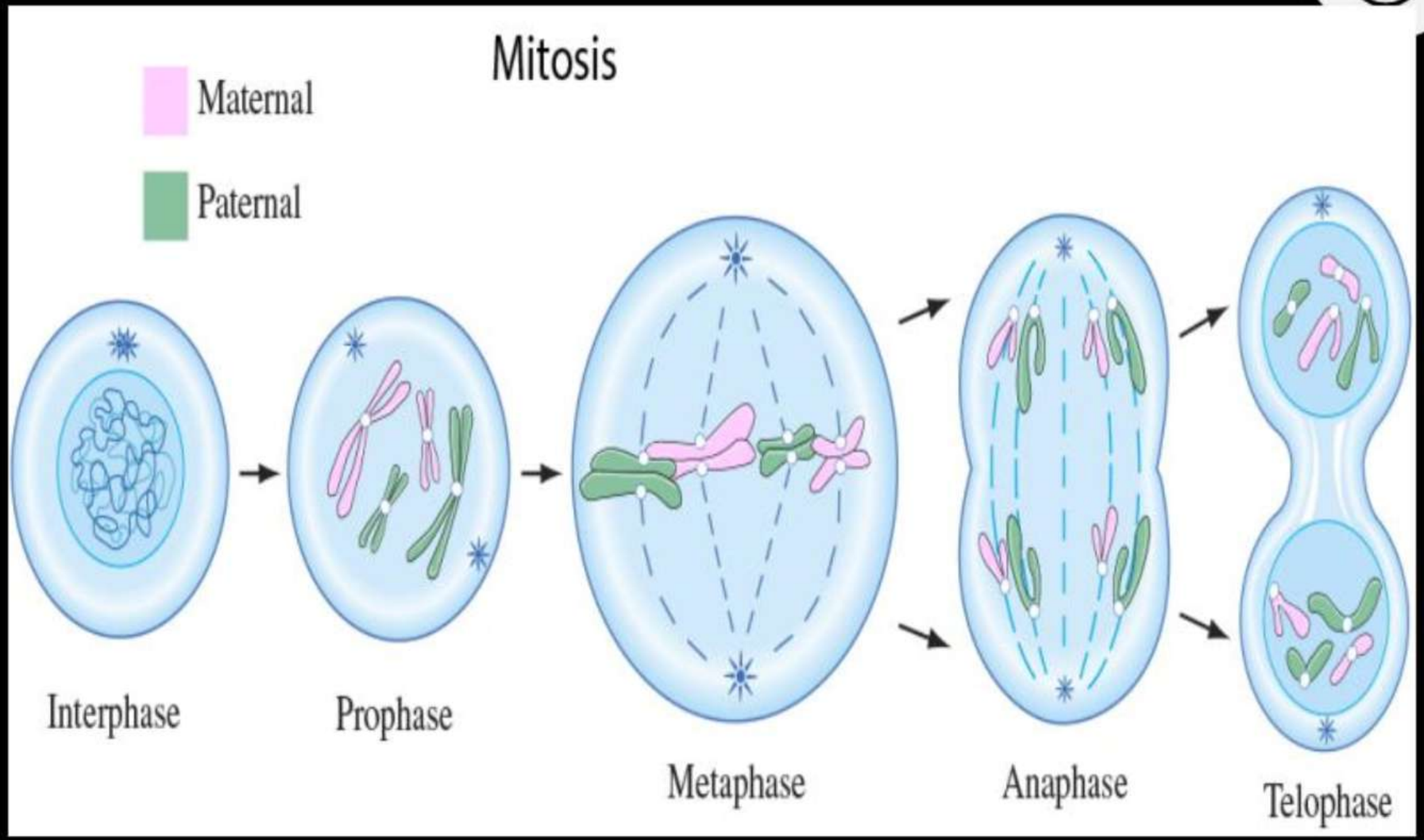
a. Represents middle lamella
b. Precursor of cell wall formation
c. Grows centrifugally

Note:-

Phragmoplast is remains of spindle fibre. (But in some books --> phragmoplast formed by GB)


CW
PM
N
N
N
N
GB
vesicle
cell plate
centrifugal growth
DC
DC
middle lamella


2·ω
1·ω
1·ω
2·ω


Mitosis
Maternal
Paternal
Interphase
Prophase
Metaphase
Anaphase
Telophase

THANK U!!