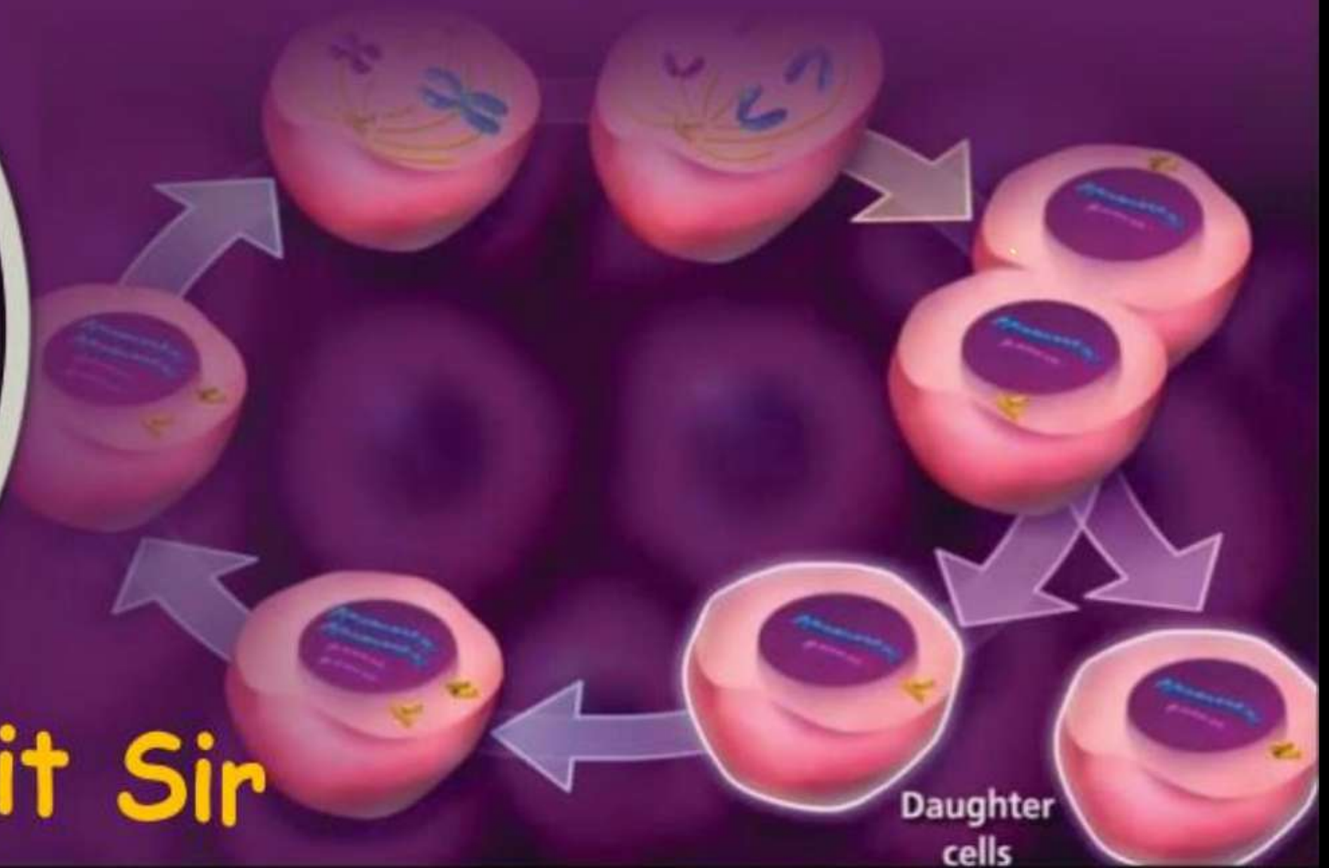
ARJUNA NEET BATCH

CELL CYCLE AND CELL DIVISION

By : Biswajit Sir



Objective of today's class

KARYOKINESIS OF MITOSIS

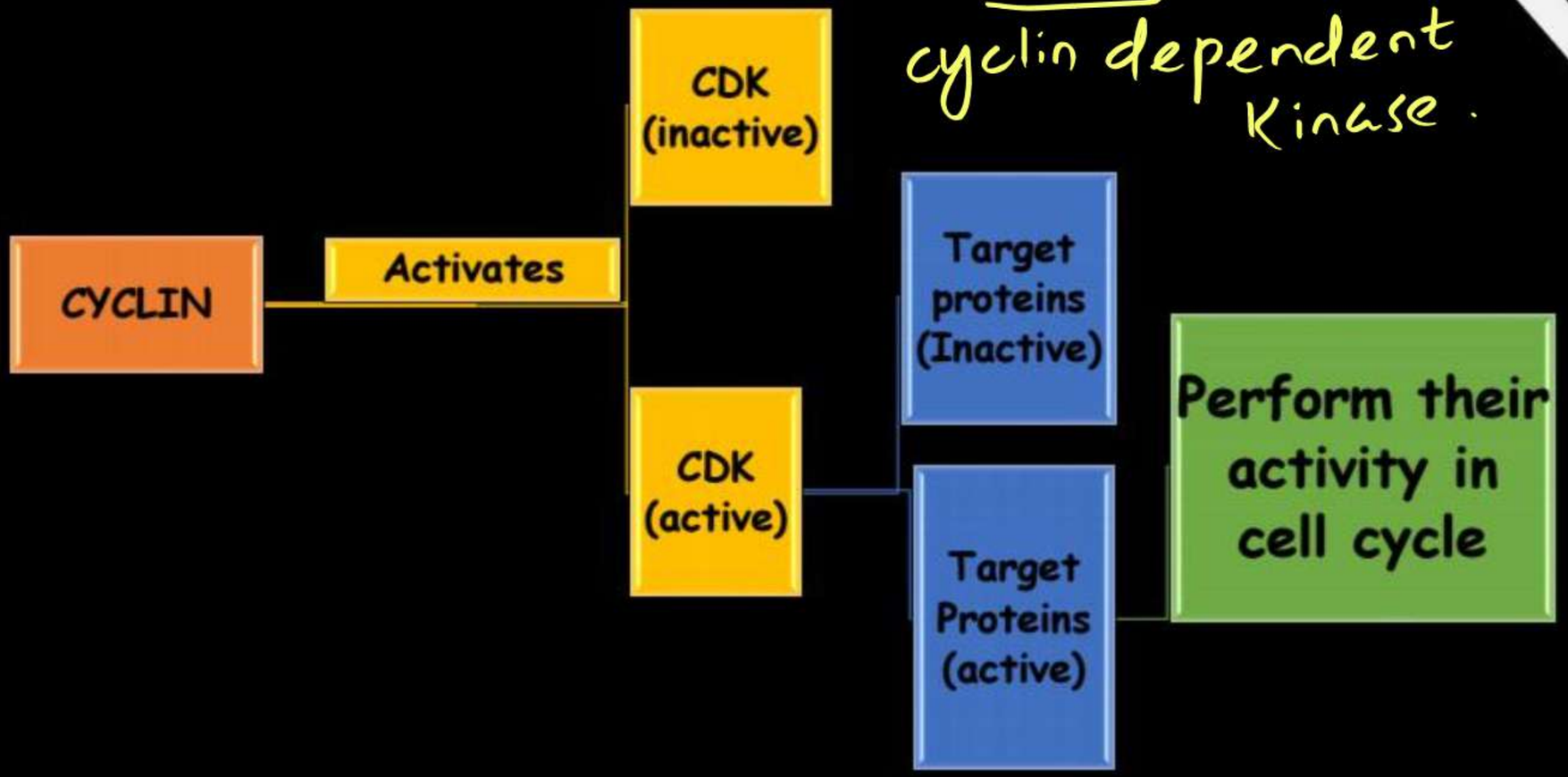
Note :

In PK (bacteria) DNA replicates before binary fission not in S phase

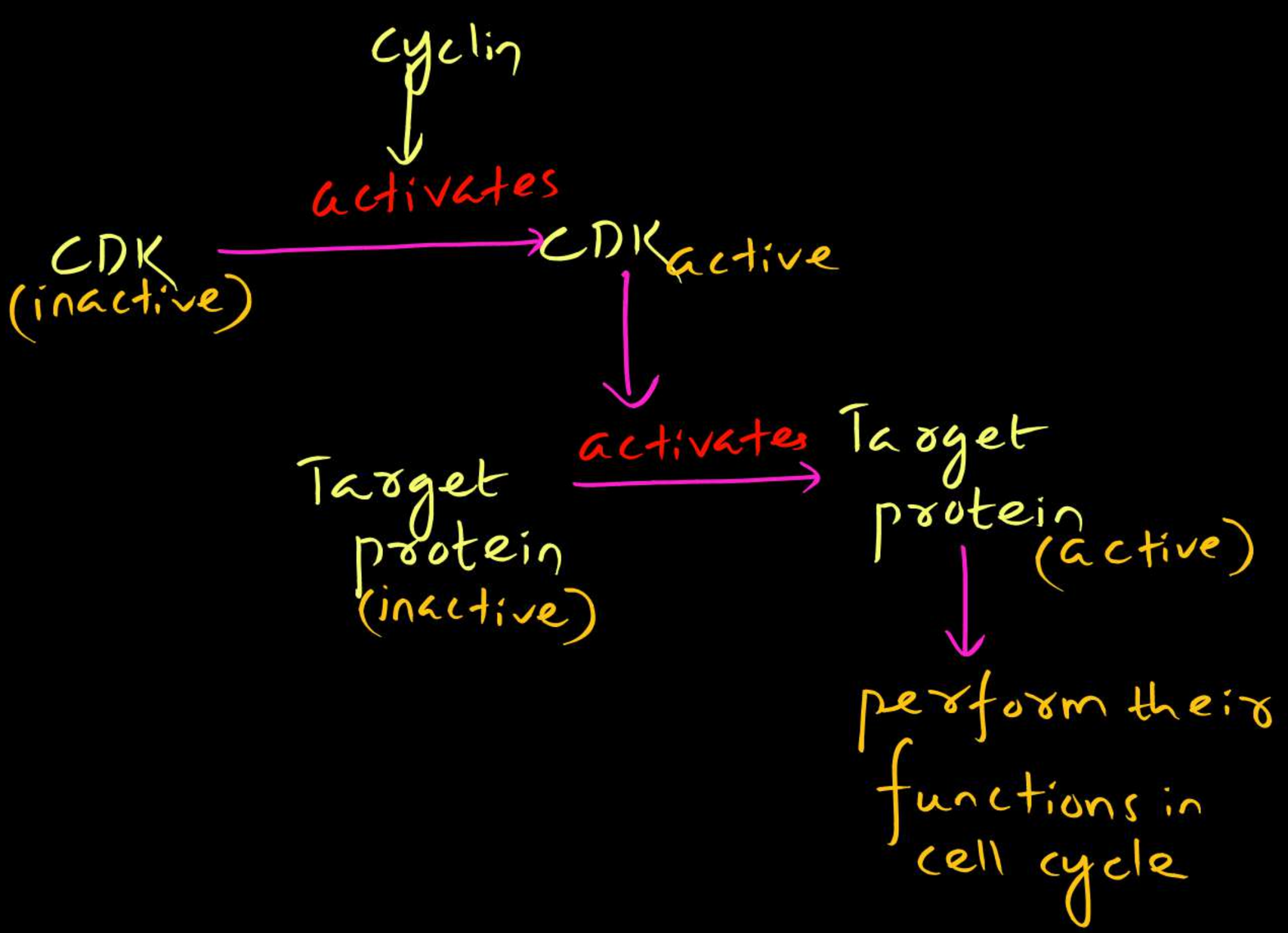
EK cell → DNA repl^{n} → S phase.

Cyclin and CDK:-

CDK
cyclin dependent Kinase.



- Cyclin → amount → varies with phases.
- CDK → amount → fixed
  → Its activity varies (sometimes active and sometime inactive)


cyclin
activates
CDK
(inactive)
CDK active
activates
Target
protein
(inactive)
Target
protein
(active)
perform their
functions in
cell cycle

Mitosis:-

Discovery →
- **Flemming (in animal cell) ,**
- **Strasburger (in plant cell)**

Term → Flemming

- **Called**

① **equational division:**

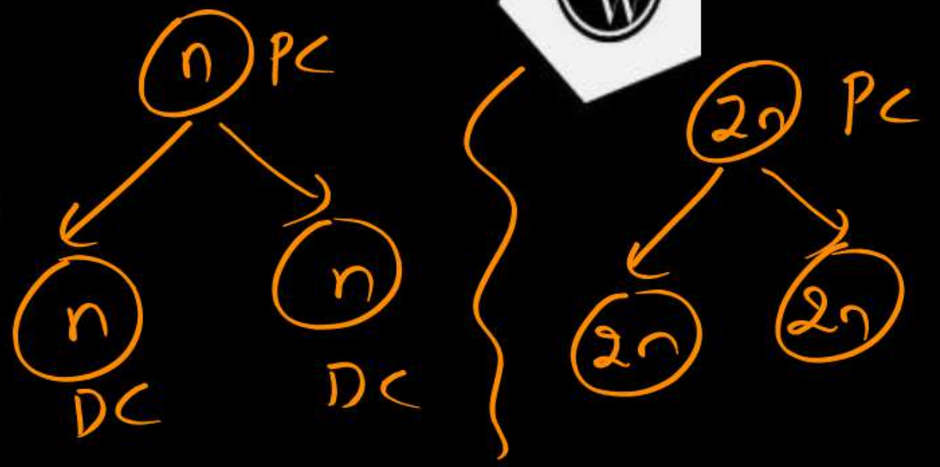
No. of chromosomes in PC = no. of chromosomes in DC.

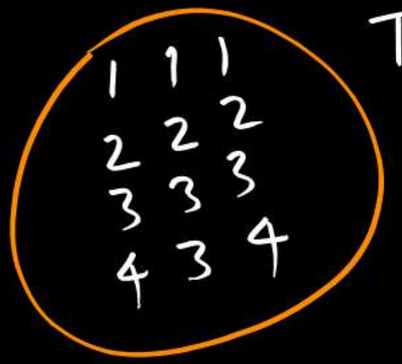
⑪ **somatic division:**

Mitosis normally takes place in somatic cell.

Note:

In animal mitosis takes place in undifferentiated germ cells as well





Triploid (3n)

mitocyte
meiocyte

Mitocyte:-

Cell undergoing mitosis.

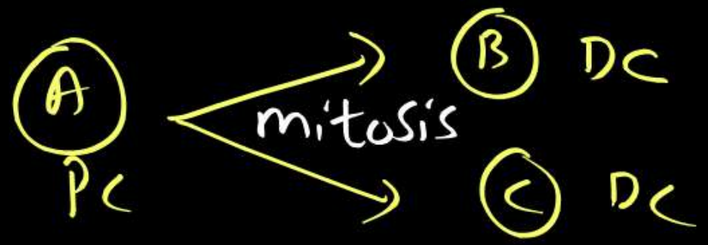
Can be n, 2n, 3n, 4n, ...etc.

In animals → 2n (normally)

Exception :- In some social insects like honey bee mitocyte – n, 2n.

In Plants → n, 2n

In mitosis the PC and DC are genetically identical.



A = B = C

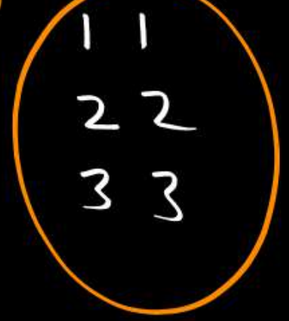
In this case cell A, B, C are identical to each other.

Reason

No crossing over takes place in mitosis.

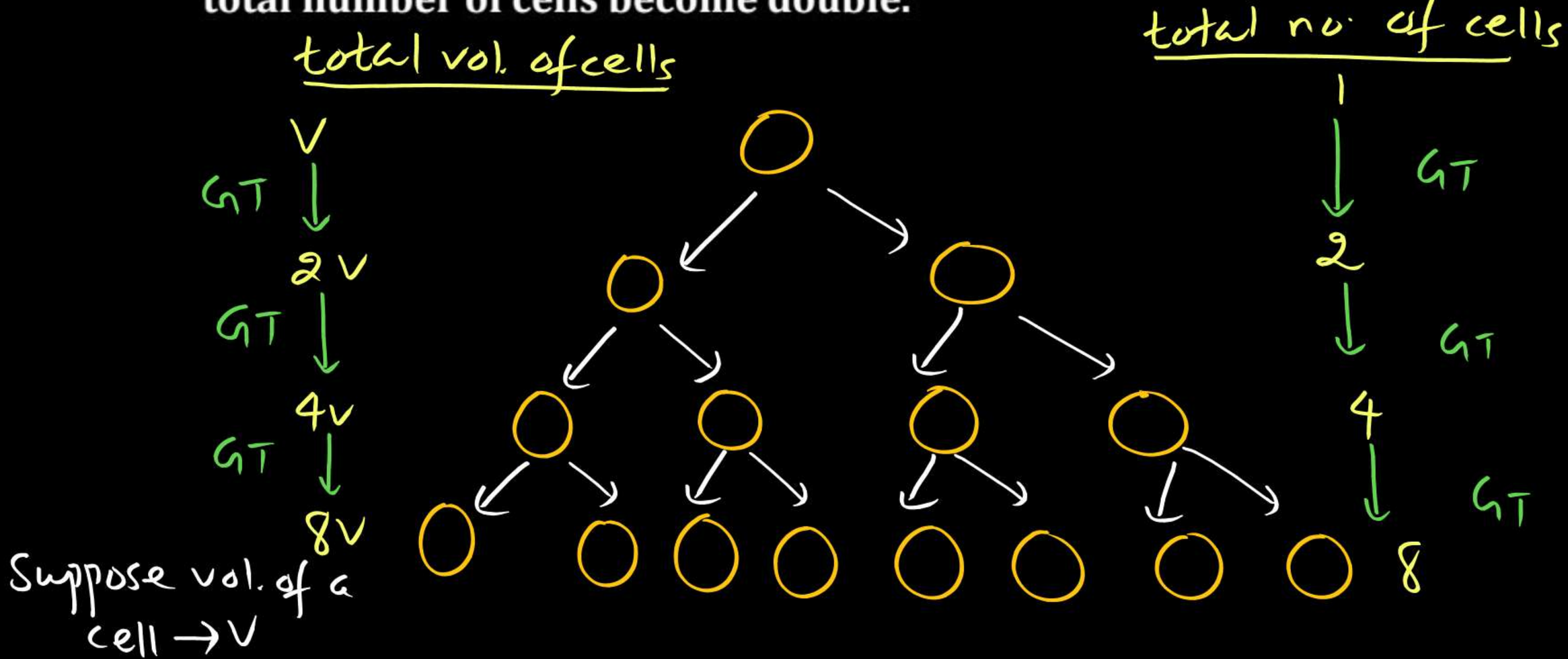
Haploid (n)

diploid (2n)



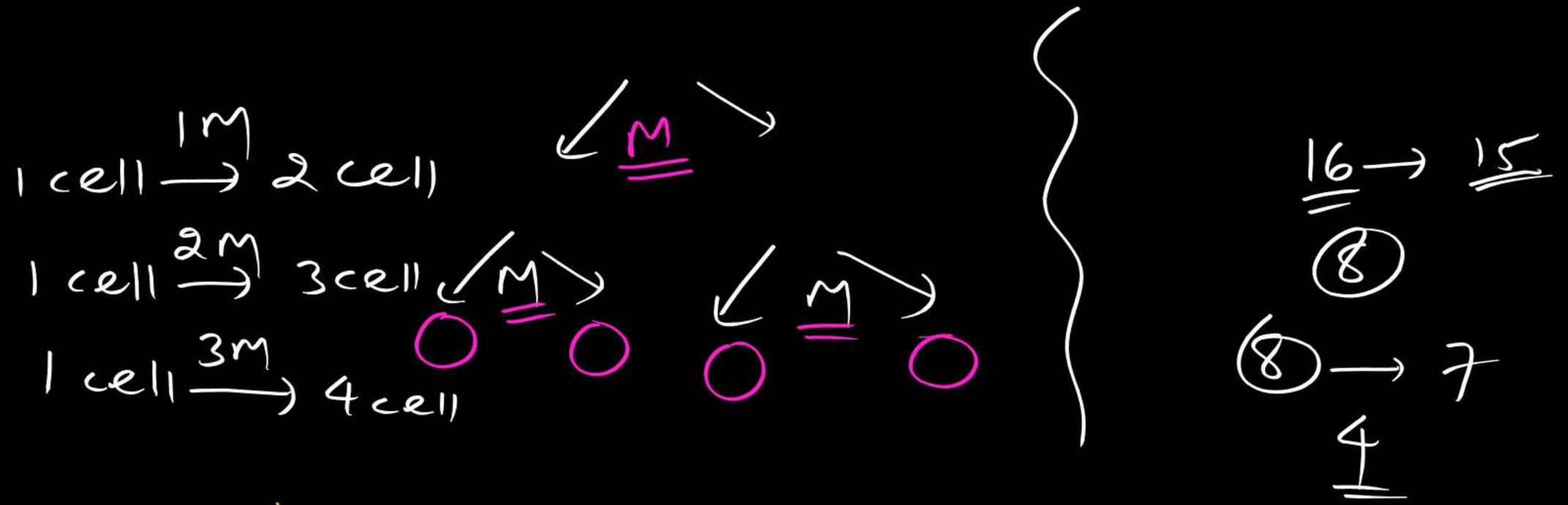
Generation time (GT):-

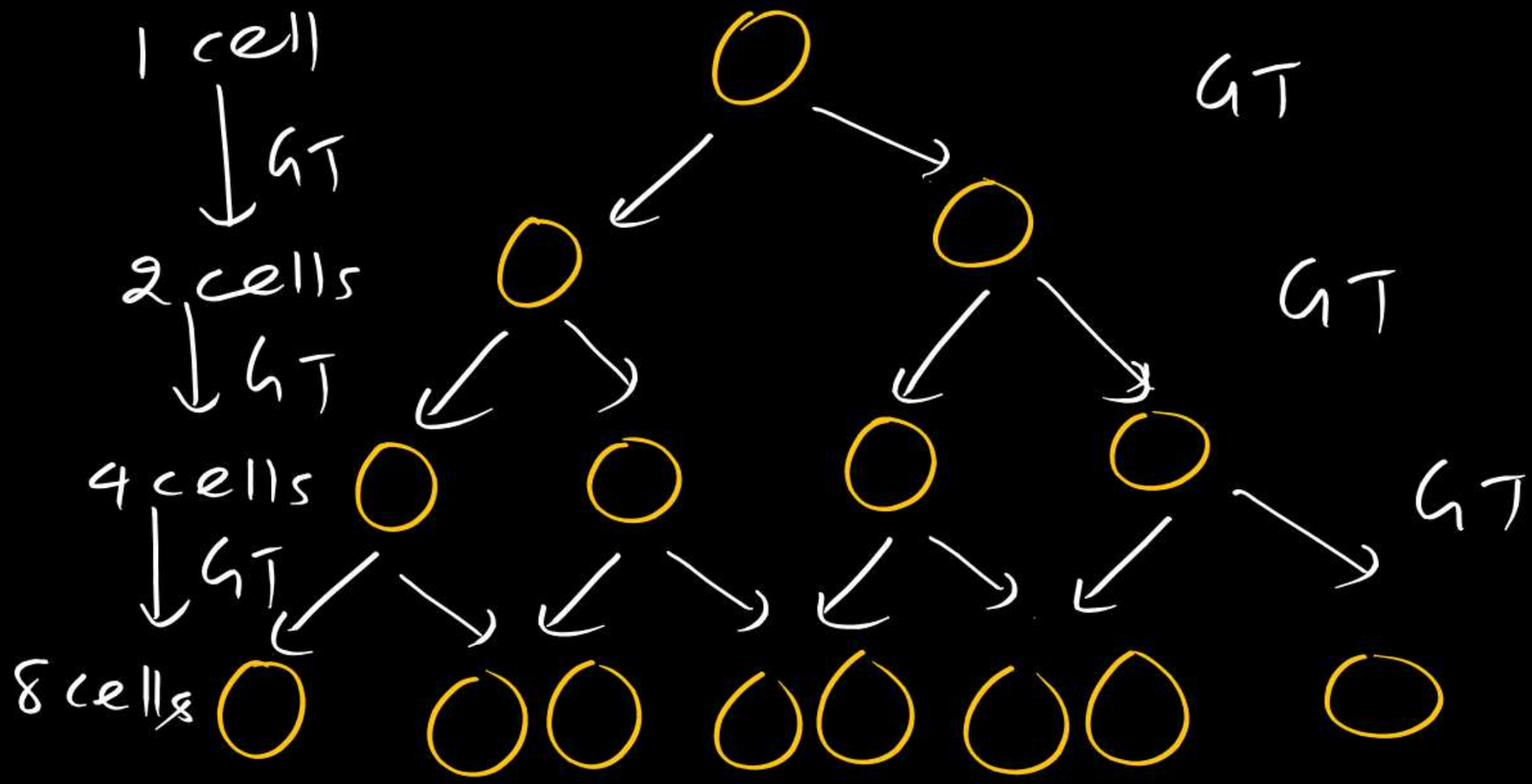
- Time taken by a cell to divide.
- After each generation (time), the total volume of cells and total number of cells become double.



Total produce X no. of cells (from single cell):-

- No. of mitosis required → X – 1
- No. of mitotic generation required → $2^n = x$ (n = no. of generation)





$$X = 2^n$$

Q1. Culture → 1000 cells (initially)
GT → 5 min
Total time → 30 min.
Total cells after 30 min. = ?

Sol. $n = \frac{30}{5} = 6$

$1 \text{ cell} \xrightarrow{6 \text{ GT}} 1 \times 2^6 = 64$

$1000 \times \text{cells} \xrightarrow{6 \text{ GT}} 1000 \times 2^6 = 64000$

64000
6000
32
900
6400

Q. If bacterial cells take 35 min (GT) for every division and if the culture initially contains 1000 bacterial cells, then what would be total no. of bacterial cells after 175 min?

Soln

$$n = \frac{175}{35} = 5$$

$$1000 \times 2^5 = 32000$$

Q/ How many mitotic division are required to produce 32 cells? (X-1)

(A) 16
(B) 31
(C) 5
(D) none

$32 - 1 = 31$

Q/ mitotic generation required to produce 32 cells from single cell?

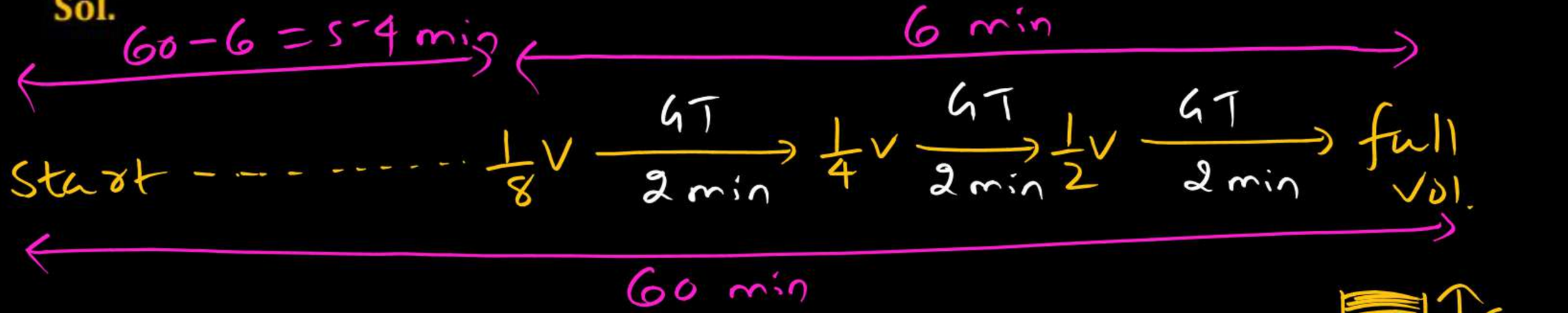
(A) 16
(B) 31
(C) 5
(D) none

$32 = 2^n$

$\Rightarrow n = 5$

Q1. Total taken by bacteria to fill the cup is 60 min.
GT → 2 min.
Time taken by bacteria to fill 1/8th vol. of cup?

Sol.



Note:-

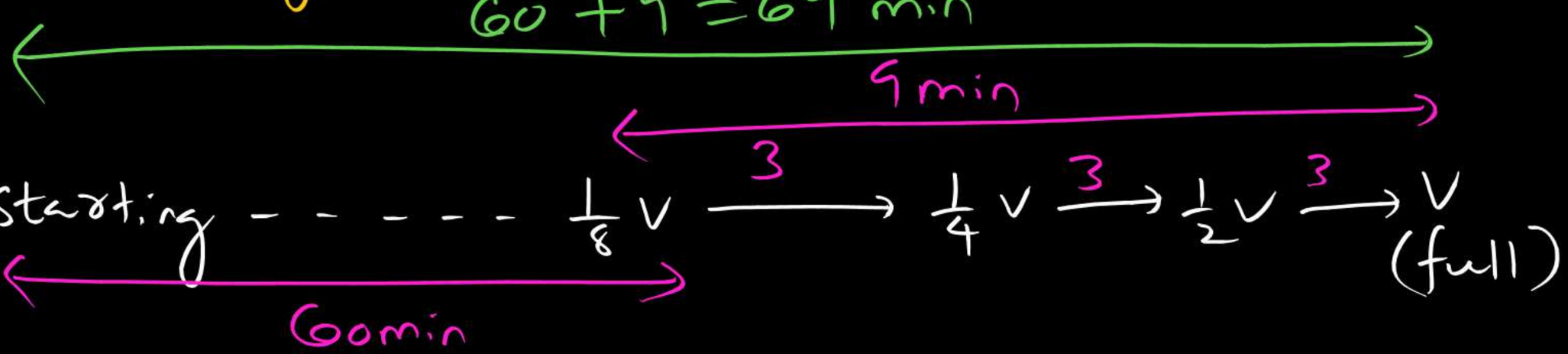
- ✓ Cell division is a progressive process and there is no clear cut lines between various stages (phases).
- ✓ For our convenience we divide cell cycle into various stages.

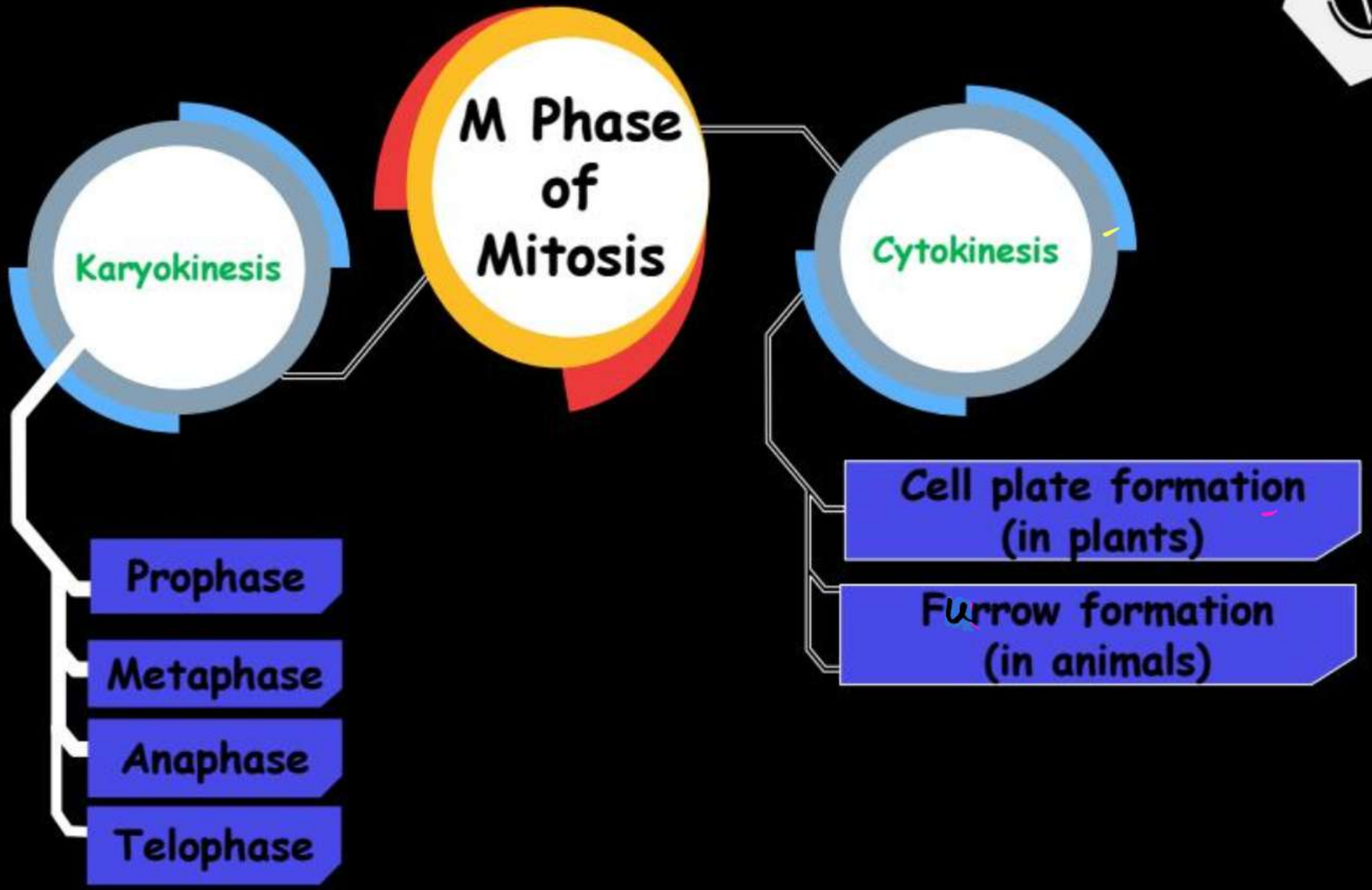
Q/ Starting $\longrightarrow$ $\frac{1}{8}$th vol $\longrightarrow$ 60 min

GT $\rightarrow$ 3 min

Starting $\rightarrow$ full vol $\rightarrow$ total time?

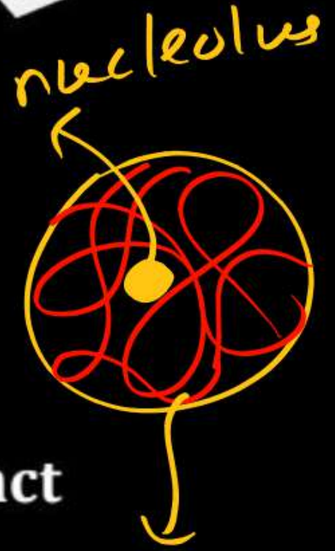
Sol^n




M Phase of Mitosis
Karyokinesis
Cytokinesis
Prophase
Metaphase
Anaphase
Telophase
Cell plate formation (in plants)
Furrow formation (in animals)

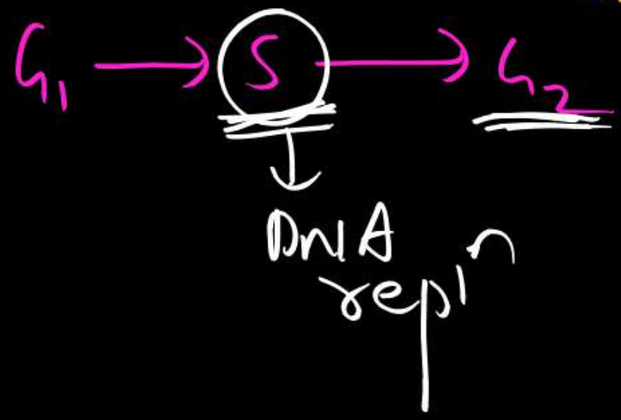
MECHANISM OF MITOSIS:-

- 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 (Pro → 1st)

- Can be divided in 3 subphases like

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

$G_1 \rightarrow S \rightarrow G_2 \rightarrow pro$

chromatin

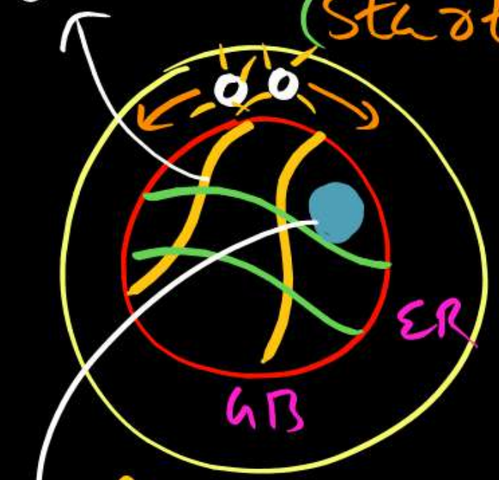
C → condensation

Early prophase

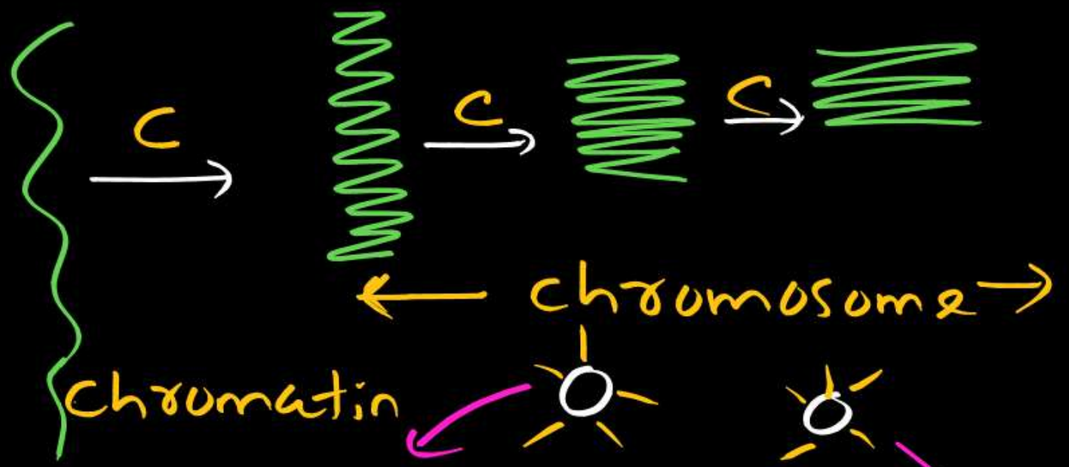
- Chromatin (chromosomal material)

Condensation. (starts) | By condesin

Chromosome



Animal cell



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

disappearing nucleolus

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 (2 asters)
  Plant cells → anastral (no aster)

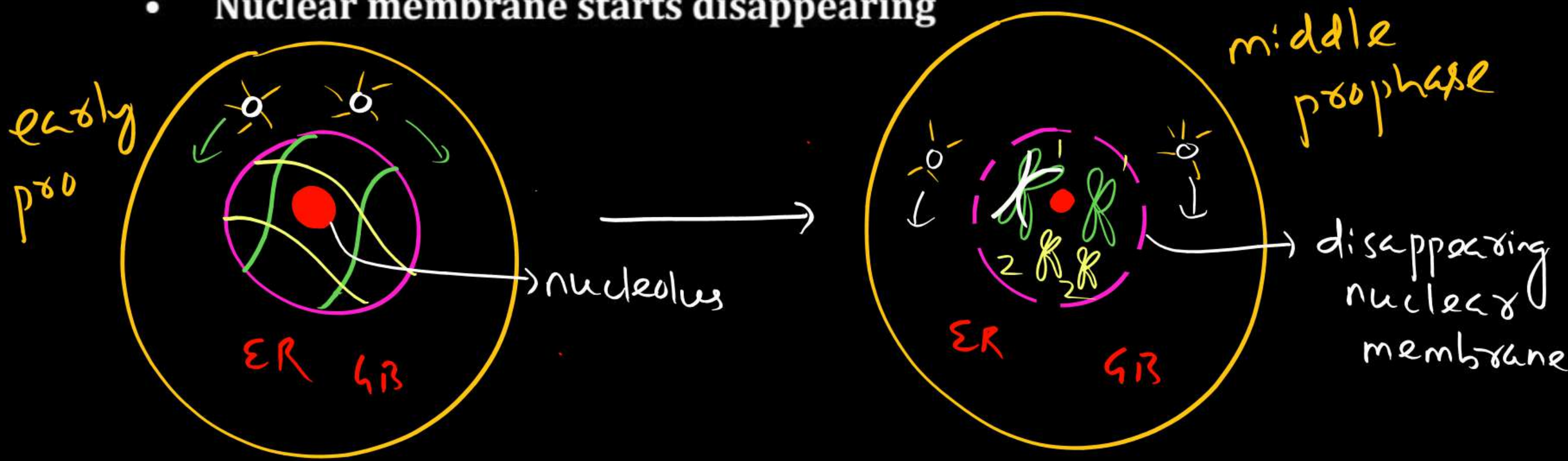
Middle prophase

- Further condensation of chromosomes

↓ result

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