YAKEEN NEET 2.0

2026

Cell Cycle and Cell Division

Botany | Lecture - 03

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Topics to be covered

1. MITOSIS
2. HAPLOID CELL :
3. NCERT BOOSTER DISCUSSION (Home work) 1 बजे With answer. Test after class
4. ~~TWO~~ ONE BROWN BOX

REVISION PLANNER.

PROPHASE

	INTERPHASE (S & G_2)	PROPHASE
INTERWINED DNA	MORE	LESS
	TANGLED (उलझा)	UNTANGLED (सुलझा DNA)
CHROMOSOMAL MATERIAL (DNA)	LEAST CONDENSED,	MORE CONDENSED.
	INDISTINCT (NOT CLEARLY VISIBLE)	DISTINCT (CLEARLY VISIBLE
	DECONDENSED FORM OF CHROMOSOME (CHROMATIN)	CONDENSED FORM OF CHROMATION (CHROMOSOME)

PROPHASE (1st stage of KARYOKINESIS).

EARLY

- BEGINS TO DISAPPEAR.
- CENTRIOLE STARTS MOVING TOWARDS OPPOSITE POLE.

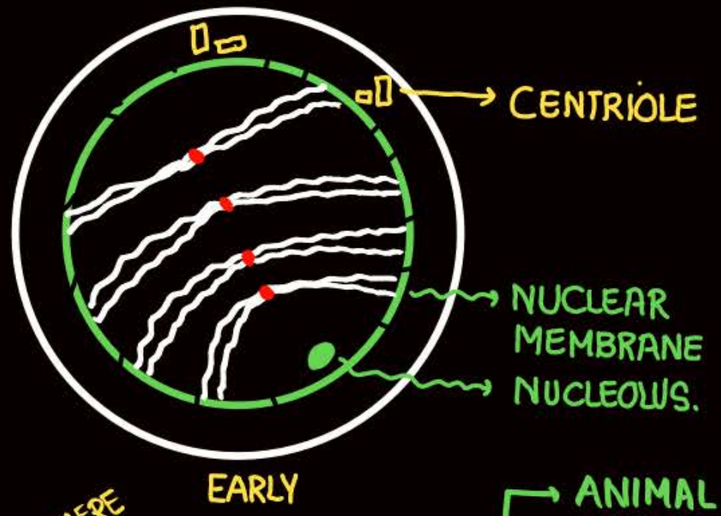
LATE / END.

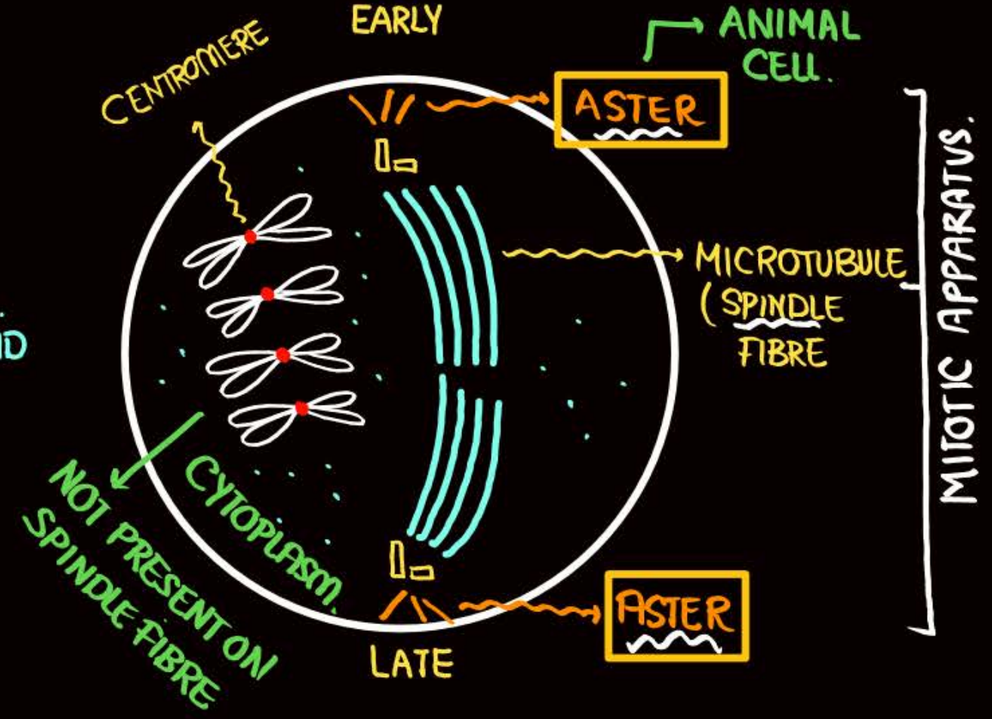
- NUCLEOLUS, NUCLEAR MEMBRANE ER, GOLGI BODY: DISAPPEARED.
- CENTRIOLE (CENTROSOME) REACHED AT OPPOSITE POLE

PROPHASE

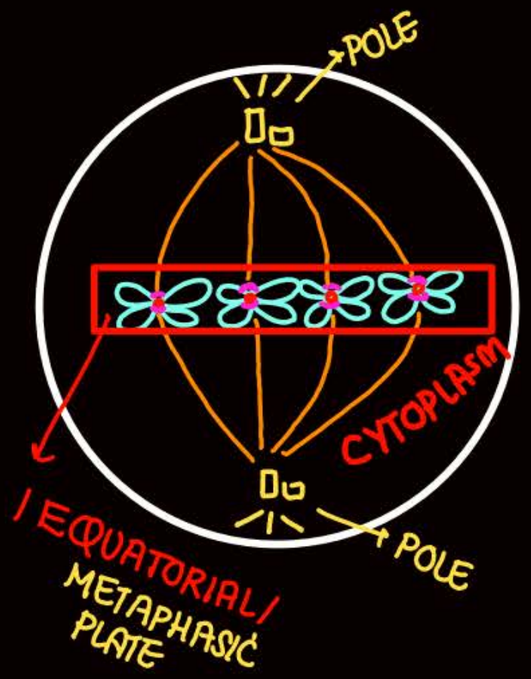
- CONDENSATION OF CHROMOSOMAL MATERIAL: BEGIN
- CHROMOSOMAL MATERIAL: UNTANGLED
- CHROMOSOME APPEAR TO CONSIST OF TWO CHROMATID CONNECTED AT CENTROMERE.

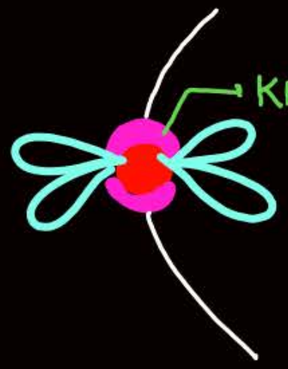
CHROMAIN (DECONDENSED FORM OF CHROMOSOME) → CHROMOSOME.





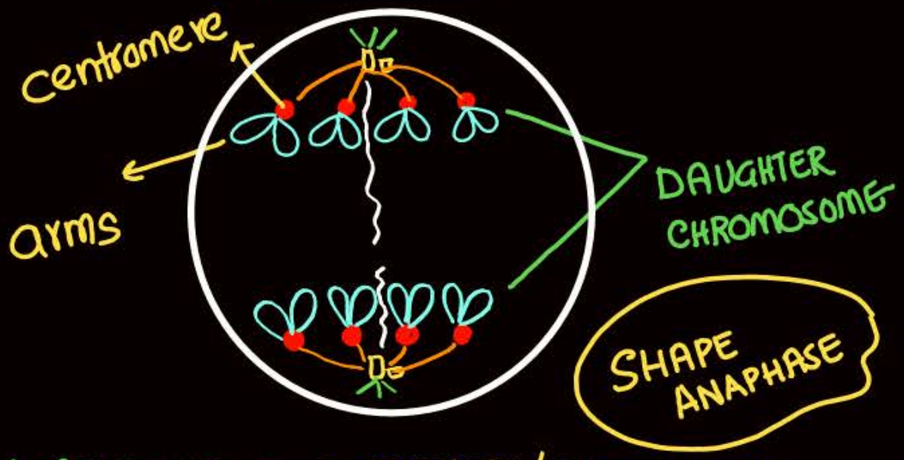
METAPHASE





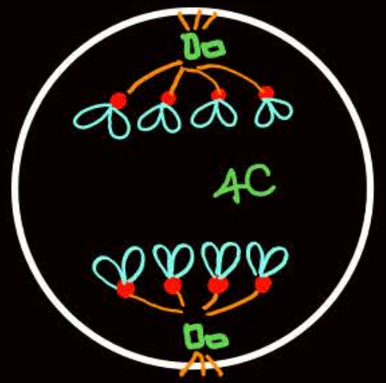
- CONDENSATION OF CHROMOSOME : COMPLETED.
- INTERPHASE ⇝ PROPHASE ⇝ METAPHASE (LESS) (MORE)
- BEST: STUDY SIZE, NO, MORPHOLOGY OF CHROMOSOME
- CHROMOSOME: MOVES: CENTRE/EQUATOR.
- ALIGNMENT OF CHROMOSOME FORM METAPHASIC PLATE.
- COMPLETE DISINTEGRATION OF NUCLEOLUS NUCLEAR MEMBRANE: IS BEGINING OF SECOND PHASE (METAPHASE)

ANAPHASE



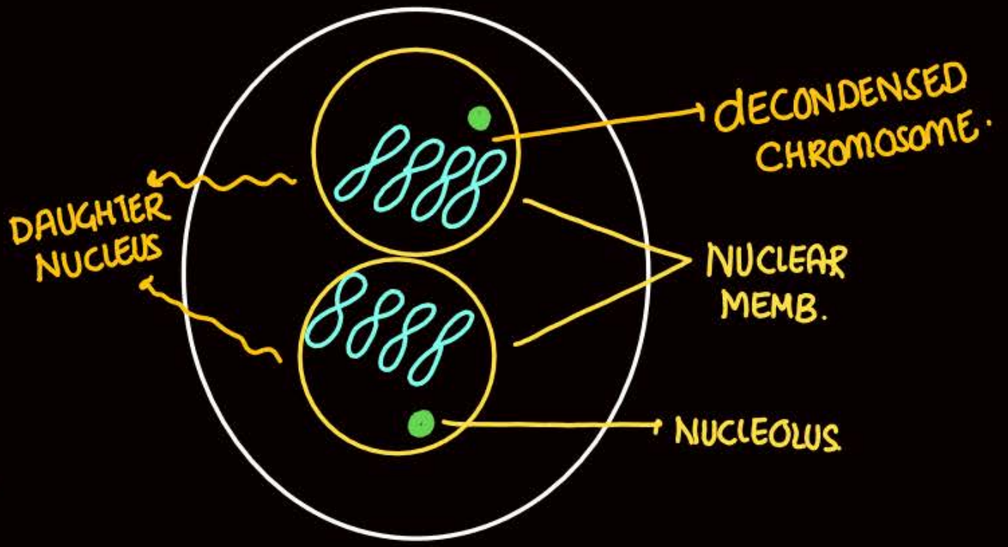
- SPLITTING OF CENTROMERE/CHROMOSOME
- CHROMATID MOVES TOWARDS OPPOSITE POLE NOW THESE CHROMATID CALLED DAUGHTER CHROMOSOME
- CHROMOSOME & CENTROMERE NO: DOUBLE
- CENTROMERE: LEADING.
  ARMS : TRAILING BEHIND

TELOPHASE



ANAPHASE

- ★ FINAL STAGE OF KARYOKINESIS
- ★ REVERSE OF PROPHASE
- ★ SPINDLE FIBRE DISAPPEAR.
- ★ CHROMOSOME DECONDENSE TO FORM CHROMATIN → EARLY TELOPHASE
- ★ CHROMOSOME LOSE THEIR IDENTITY. → EARLY TELOPHASE
- ★ NUCLEOLUS, NM, GOLGI BODY, ER REAPPEAR. → LATE TELOPHASE
- ★ TWO NUCLEUS IN ONE CELL (KARYOKINESIS COMPLETED)



CYTOKINESIS

DAUGHTER CELL.

NOTE

	NO. OF CHROMOSOME	DNA CONTENT	NO. OF CHROMATID IN ONE CHROMOSOME
PARENT CELL	4	2C	1
G_1	4	2C	1
S	4	4C	2
G_2	4	4C	2
PROPHASE	4	4C	2
METAPHASE	4	4C	2
ANAPHASE	8	4C	1
TELOPHASE	4	2C	1

NOTE (2n)

	DNA
PARENT	2C
G_1	2C
S	4C
G_2	4C
M	2C

(N)

1C

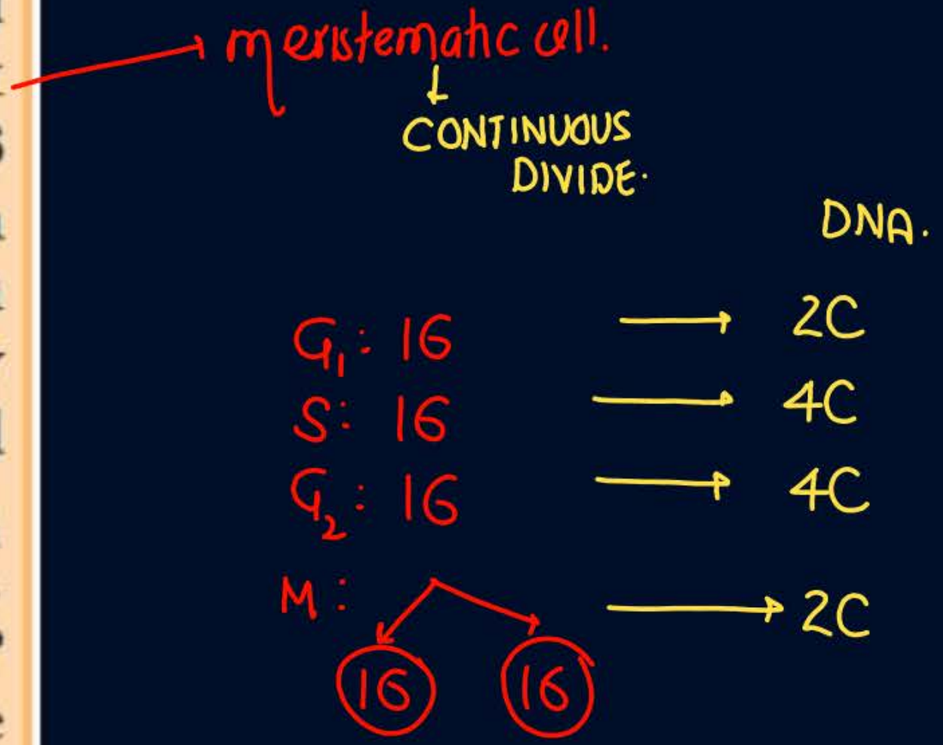
1C

2C

2C

1C in each cell.

You have studied mitosis in onion root tip cells. It has 16 chromosomes in each cell. Can you tell how many chromosomes will the cell have at G_1 phase, after S phase, and after M phase? Also, what will be the DNA content of the cells at G_1, after S and at G_2, if the content after M phase is 2C?



10.2 M PHASE

DOUBLE : INTERPHASE.
+ TWO CELL.

This is the most dramatic period of the cell cycle, involving a major reorganisation of virtually all components of the cell. Since the number of chromosomes in the parent and progeny cells is the same, it is also called as ***equational division***. Though for convenience mitosis has been divided into four stages of nuclear division (karyokinesis), it is very essential to understand that cell division is a progressive process and very clear-cut lines cannot be drawn between various stages. Karyokinesis involves following four stages:

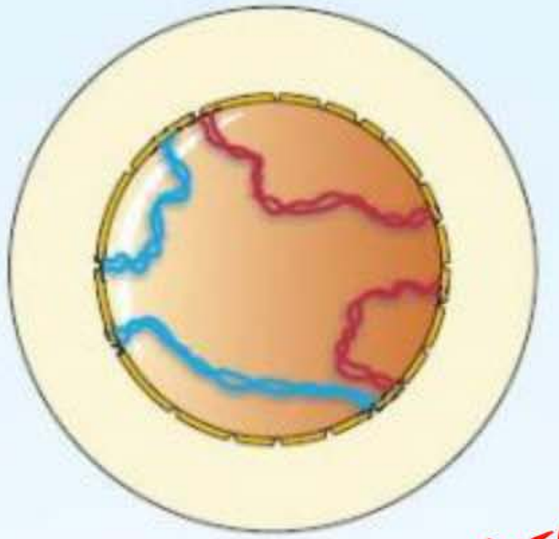
- *Prophase* ✓
- *Metaphase* ✓
- *Anaphase* ✓
- *Telophase* ✓

10.2.1 Prophase

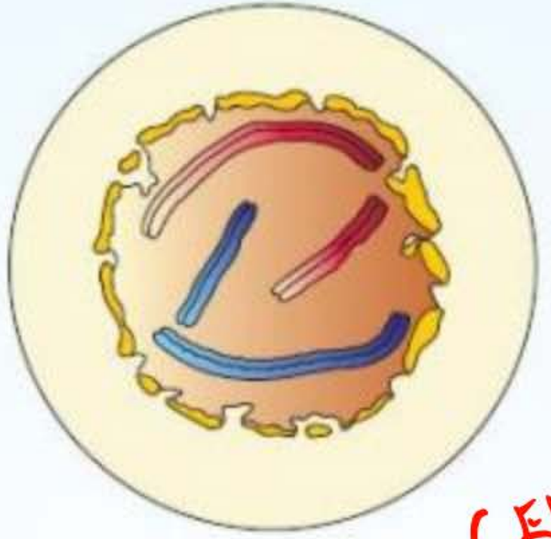
Prophase which is the first stage of karyokinesis of mitosis follows the S and G_2 phases of interphase. In the S and G_2 phases, the new DNA molecules formed are not distinct but intertwined. Prophase is marked by the initiation of condensation of chromosomal material. The chromosomal material becomes untangled during the process of chromatin condensation (Figure 10.2 a). The centrosome, which had undergone duplication during S phase of interphase, now begins to move towards opposite poles of the cell. The completion of prophase can thus be marked by the following characteristic events:

- Chromosomal material condenses to form compact mitotic chromosomes. Chromosomes are seen to be composed of two chromatids attached together at the centromere.
- Centrosome which had undergone duplication during interphase, begins to move towards opposite poles of the cell. Each centrosome radiates out microtubules called asters. The two asters together with spindle fibres forms mitotic apparatus.

Cells at the end of prophase, when viewed under the microscope, do not show golgi complexes, endoplasmic reticulum, nucleolus and the nuclear envelope.



Early Prophase (START)



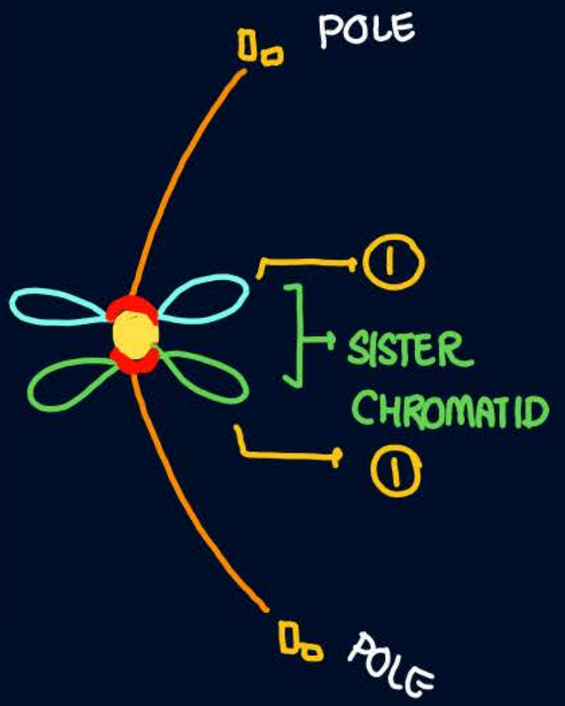
Late Prophase (END)

(a)

10.2.2 Metaphase

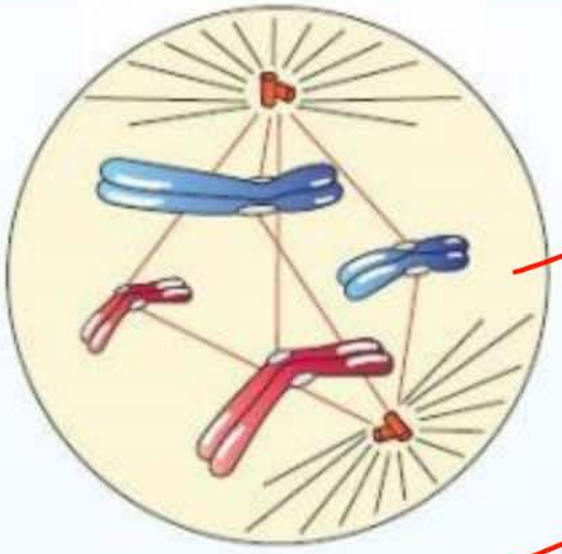
The complete disintegration of the nuclear envelope marks the start of the second phase of mitosis, hence the chromosomes are spread through the cytoplasm of the cell. By this stage, condensation of chromosomes is completed and they can be observed clearly under the microscope. This then, is the stage at which morphology of chromosomes is most easily studied. At this stage, metaphase chromosome is made up of two sister chromatids, which are held together by the centromere (Figure 10.2 b).

Small disc-shaped structures at the surface of the centromeres are called kinetochores. These structures serve as the sites of attachment of spindle fibres to the chromosomes that are moved into position at the centre of the cell. Hence, the metaphase is characterised by all the chromosomes coming to lie at the equator with one chromatid of each chromosome connected by its kinetochore to spindle fibres from one pole and its sister chromatid connected by its kinetochore to spindle fibres from the opposite pole (Figure 10.2 b).



The plane of alignment of the chromosomes at metaphase is referred to as the **metaphase plate.** The key features of metaphase are:

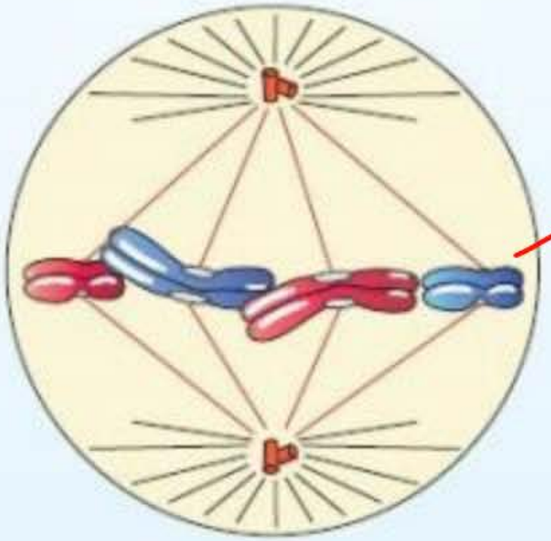
- Spindle fibres attach to kinetochores of chromosomes.
- Chromosomes are moved to spindle equator and get aligned along metaphase plate through spindle fibres to both poles.



NOT ON EQUATOR.

BEFORE METAPHASE.

Transition to Metaphase



CENTRE

Metaphase

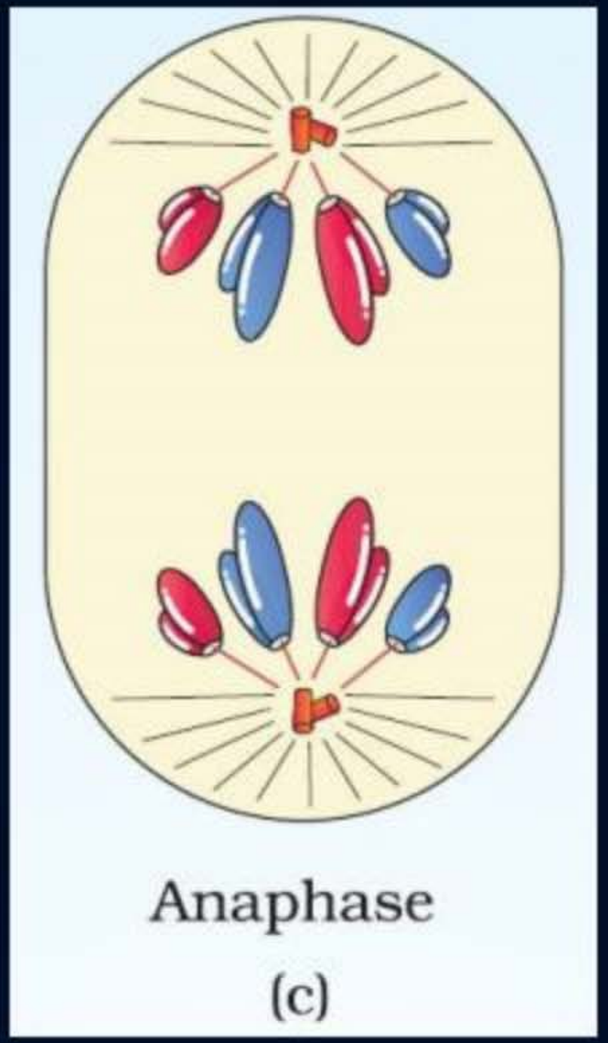
(b)

10.2.3 Anaphase

METAPHASE → TELOPHASE

At the onset of anaphase, each chromosome arranged at the metaphase plate is split simultaneously and the two daughter chromatids, now referred to as daughter chromosomes of the future daughter nuclei, begin their migration towards the two opposite poles. As each chromosome moves away from the equatorial plate, the centromere of each chromosome remains directed towards the pole and hence at the leading edge, with the arms of the chromosome trailing behind (Figure 10.2 c). Thus, anaphase stage is characterised by the following key events:

- Centromeres split and chromatids separate.
- Chromatids move to opposite poles.



Anaphase

(c)

10.2.4 Telophase

At the beginning of the final stage of karyokinesis, i.e., telophase, the chromosomes that have reached their respective poles decondense and lose their individuality. The individual chromosomes can no longer be seen and each set of chromatin material tends to collect at each of the two poles (Figure 10.2 d).

This is the stage which shows the following key events:

- Chromosomes cluster at opposite spindle poles and their identity is lost as discrete elements.
- Nuclear envelope develops around the chromosome clusters at each pole forming two daughter nuclei.
- Nucleolus, golgi complex and ER reform.

Homework from YAKEEN NEET 2.0 2026 Module

Ex-①

CELL CYCL & PHASE : ALL QUESTION

M PHASE : 1. 1.

M : MITOSIS

T : CYTOKINESIS, SIGNIF OF MITOSIS, PROPHASE-I + MITOSIS REVN.

W : PROP-I REVN + ER, GB, LYSO, VACUOLE

T : MITO, CHLOROP.

F : NUCLEUS & CHROMOSOM.

S : ?

THANK YOU