

Disclaimer

Copyright © ICSE StudyMate. Any unauthorized use and/or duplication of this material without express and written permission from this site's author and/or owner is strictly prohibited. Excerpts and links may be used, provided that full and clear credit is given to ICSE StudyMate with appropriate and specific direction to the original content. Infringement of the copyright may lead to charges under the Indian Copyright Act.

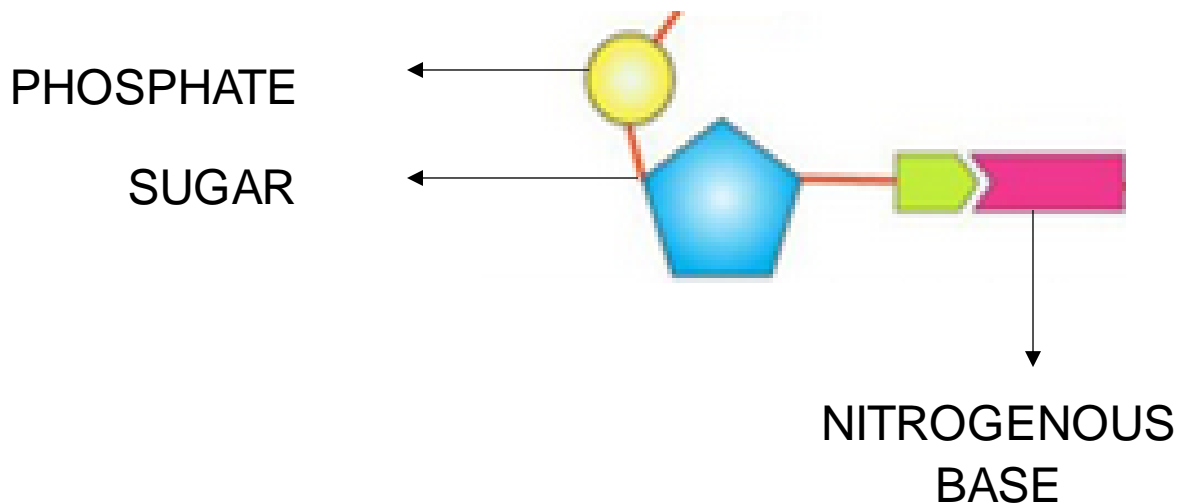
ICSE BIOLOGY

CHAPTER 1: STRUCTURE OF CHROMOSOMES, CELL CYCLE AND CELL DIVISION

A) CHROMOSOMES:

- 1) DEFINITION: CHROMOSOMES ARE HIGHLY COILED AND CONDENSED CHROMATIN FIBRES.
- 2) FUNCTION: Chromosomes are CARRIER OF GENES.
- 3) Discovered by WALTHER FLEMING.
- 4) STRUCTURE: a) Chromosomes are highly coiled and condensed CHROMATIN FIBRES and the CHROMATIN MATERIAL which constitutes the chromatin fibres is formed of:
 - DNA: DEOXYRIBONUCLEIC ACID:
 - The shape of DNA molecule first studied by ROSALIND FRANKLIN.
 - STRUCTURE OF DNA made by WATSON AND CRICK.
 - STRUCTURE OF DNA: DOUBLE STRANDED HELICAL STRUCTURE.
 - DNA is also described as MACROMOLECULE-
Reason: A single DNA molecule is very large.
 - COMPOSITION:
 - TWO COMPLEMENTARY STRANDS wound around each other in a DOUBLE HELIX.
 - Each DNA strand composed of REPEATING NUCLEOTIDES which is made up of: PHOSPHATE, SUGAR ARRANGED LENGTHWISE and NITROGENOUS BASE attached to the SUGAR INWARDS which extends to join the COMPLEMENTARY NITROGENOUS BASE from the other strand by a HYDROGEN BOND.

- Four types of NITROGENOUS BASE: ADENINE-THYMINE, GUANINE-CYTOSINE (Remember it in this order itself so that no confusion is created while recalling which compound pairs with which) Where ADENINE pairs with THYMINE and CYTOSINE pairs with GUANINE



THE BASIC STRUCTURE OF
A NUCLEOTIDE

- HISTONE PROTEINS:
 - DEFINITION: HISTONES ARE THE PROTEINS THAT HELP IN THE COILING AND PACKAGING OF DNA INTO STRUCTURAL UNITS CALLED NUCLEOSOMES.
 - FUNCTION: COINLING AND PACKAGING OF DNA into structural units.

- DEFINITION OF NUCLEOSOME: The DNA STRANDS WIND AROUND A CORE OF EIGHT HISTONE PROTEINS WHERE EACH SUCH COMPLEX IS CALLED NUCLEOSOME.
- The CORE OF EIGHT HISTONE PROTEINS is called as HISTONE OCTAMER.

b) Each chromosome consists of TWO SISTER CHROMATIDS joined at some point along the length.

- This POINT OF ATTACHMENT is called as CENTROMERE.
- DEFINITION OF CENTROMERE: CENTROMERE IS A SMALL CONSTRICTED REGION WHICH SERVES AS A POINT OF ATTACHMENT BETWEEN TWO SISTER CHROMATIDS.

FUNCTION: 1) Serves as a POINT OF ATTACHEMENT between two sister chromatids.

2) Serves to ATTACH TO THE SPINDLE FIBRE during cell division.

5) After the completion of cell division, the SISTER CHROMATIDS of the chromosome DECONDENSE and come back to their original form of LONG THREAD-LIKE CHROMATIN FIBRES.

B) GENES:

- 1) DEFINITION: GENES ARE SPECIFIC SEQUENCES OF NUCLEOTIDES ON A CHROMOSOME, THAT ENCODES PARTICULAR PROTEINS WHICH EXPRESS IN THE FORM OF SOME PARTICULAR FEATURE OF THE BODY.

2) Genes are UNIT OF HEREDITY.

3) FUNCTION: Responsible for SPECIFIC CHARACTERISTICS OF THE OFFSPRING.

C) NEED FOR NEW CELLS:

1) FOR GROWTH, 2) FOR REPLACEMENT, 3) FOR REPAIR, 4) FOR REPRODUCTION

D) CELL CYCLE:

1) Some requirements are to be met by the cell before it divides, and those requirements are:

- The cell must GROW
- It should SYNTHESIZE material like PROTEINS, RNA, etc.
- DUPLICATE its DNA

2) DEFINITION: THE CELL CYCLE IS A SERIES OF EVENTS THAT TAKE PLACE IN A CELL LEADING TO THE DUPLICATION OF ITS DNA AND THE SUBSEQUENT DIVISION OF THE CELL TO PRODUCE TWO DAUGHTER CELLS.

3) Cell cycle has TWO PHASES:

- A NON-DIVIDING phase called the INTERPHASE
- A DIVIDING phase called the M-PHASE or MITOSIS

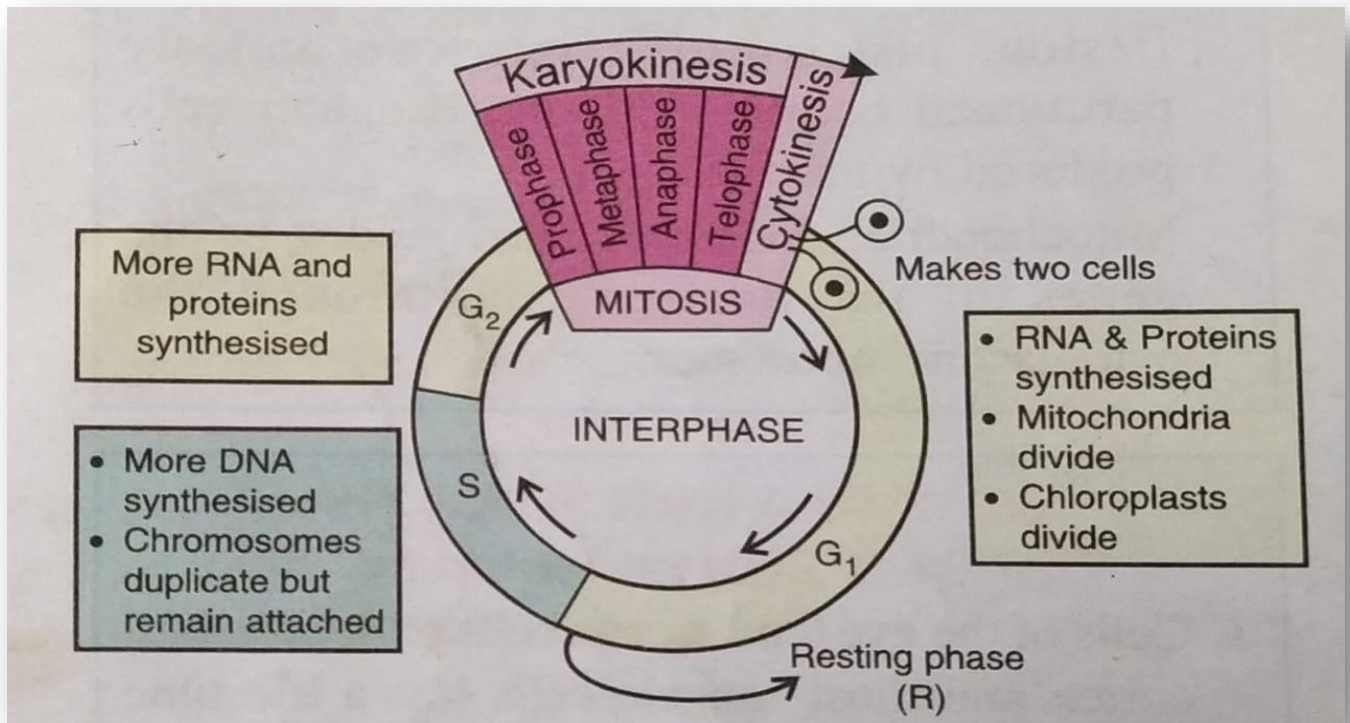
E) INTERPHASE:

- 1) The two daughter cells produced are different from the mother cell in TWO ways:
 - They are RELATIVELY SMALL.
 - They have FULL SIZED NUCLEUS but RELATIVELY LESS CYTOPLASM

When the daughter cells are in the conditions stated above, they are said to BE IN INTERPHASE.

- 2) Since no change is visible in the chromosomes EXTERNALLY during the interphase, this phase was formerly called as the resting phase but in reality, the cell is quite active during INTERPHASE while SYNTHESISING MORE DNA.
- 3) The interphase is again divided into more THREE phases:
 - THE FIRST GROWTH PHASE:
 - RNA AND PROTEINS ARE SYNTHESIZED
 - VOLUME OF CYTOPLASM INCREASES
 - MITOCHONDRIA AND CHLOROPASTS WHICH HAVE THEIR OWN DNA DIVIDE.
 - In late first growth phase the cells must one of the two paths listed:
 - They may either WITHDRAW from the cell cycle and enter a RESTING PHASE OR
 - Start preparing for the NEXT DIVISION by entering the next phase i.e. the SYNTHESIS PHASE

- THE SYNTHESIS PHASE:
 - More DNA is SYNTHESIZED
 - CHROMOSOMES are DUPLICATED
- SECOND GROWTH PHASE:
 - RNA and PROTEINS are SYNTHESIZED
 - This is the SHORTEST PHASE of the INTERPHASE



CELL CYCLE-

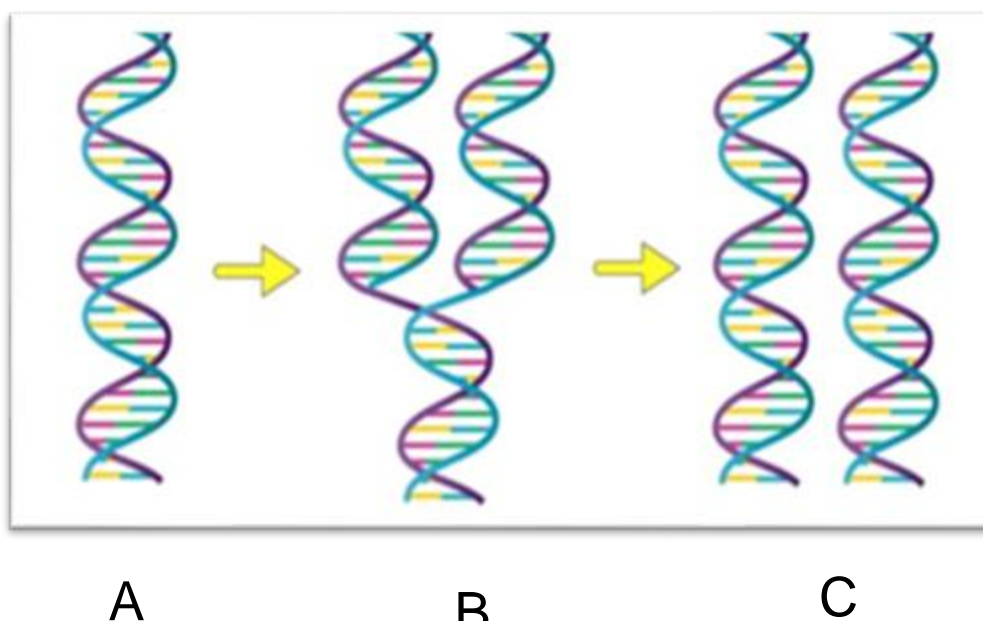
G₁ - FIRST GROWTH PHASE

S - SYNTHESIS PHASE

G₂ - SECOND GROWTH PHASE

F) FORMATION OF THE NEW DNA:

- 1) During the SYNTHESIS PHASE of interphase each DNA MOLECULE DUPLICATES for their EQUAL DISTRIBUTION in the TWO DAUGHTER CELLS DURING MITOSIS.
- The DNA DOUBLE HELIX opens at one end
 - The two strands of the DNA GETS FREE
 - To these free strands NEW STRANDS BEGIN TO FORM and the process continues in a sequence for the whole length of the DNA.



DIAGRAM* :

A: DOUBLE HELIX

B: TWO STRANDS OPEN AT ONE END AND A NEW STAND IS PRODUCED AGAINST EACH SIMULTANEOUSLY

C: EACH NEW DNA CONTAINS ONE ORIGINAL STRAND AND ANOTHER NEW ONE

G) LIFE SPAN OF DIFFERENT CELLS:

- 1) BRAIN CELLS AND OTHER NERVE CELLS ONCE FORMED IN THE EMBRYO DON'T DIVIDE FURTHER, ONCE DEAD THEY ARE NOT REPLACED.
- 2) LIVER CELLS MAY DIVIDE ONLY ONCE EVERY TWO YEAR TO REPLACE DAMAGED CELLS.
- 3) SURFACE SKIN CELLS ARE CONTINUOUSLY LOST AND REPLACED BY THE UNDERLYING CELLS.
- 4) IN PLANTS, AT THE MERISTEMS THE CELLS DIVIDE VERY RAPIDLY TO PRODUCE NEW LEAVES, BUDS, FLOWERS, ETC.

NOTE*: Uncontrolled non-stop cell cycles may lead to TUMOURS that may or may not be CANCEROUS.

H) CELL DIVISION:

- 1) There are two types of cell division:
 - MITOSIS: DEFINITION- MITOSIS IS THE TYPE OF CELL DIVISION LEADING TO THE PRODUCTION OF DIPLOID CELLS FOR GROWTH AND DEVELOPMENT.
 - MEOSIS: DEFINITION- MEOSIS IS THE TYPE OF CELL DIVISION LEADING TO THE PRODUCTION OF HAPLOID CELLS FOR REPRODUCTION.

I) MITOSIS:

- 1) It is the cell division in which one PARENT CELL divides into TWO IDENTICAL DAUGHTER CELLS.
- 2) The SAME NUMBER OF CHROMOSOME NUMBER is maintained at EACH CELL DIVISION.
- 3) There are two phases of mitosis:
 - KARYOKINESIS- It means division of nucleus which is again divided into four phases:
 - PROPHASE
 - METAPHASE
 - ANAPHASE
 - TELEPHASE

Note*: REMEMBER THESE PHASES WITH THE ACRONYM P-MAT

P-rophase

M-etaphase

A-naphase

T-elophase

- PROPHASE:

- The chromosomes have become SHORT AND THICK.
- They are CLEARLY VISIBLE inside the nucleus
- Each chromosome has ALREADY DUPLICATED TO FORM TWO CHROMATIDS.
- Two sister chromatids remain attached to each other through a SMALL REGION CALLED CENTROMERE.
- *The CENTROSOME SPLITS INTO TWO along with the DUPLICATION OF THE CENTRIOLES
- The centrioles occupy OPPOSITE POLES OF THE CELL.
- *Each centriole is surrounded by RADIATING RAYS CALLED ASTERS.
- *A number of FIBRES appears between the two daughter centrioles called as the SPINDLE FIBRES
- The nuclear membrane and the nucleolus disappear
- The chromosomes start moving TOWARDS THE EQUATOR of the cell
- *This is the longest phase of mitosis

NOTE*: From the points stated above, only up to 4-5 points are to be learned, and the point highlighted by an asterisk should be learned thoroughly.

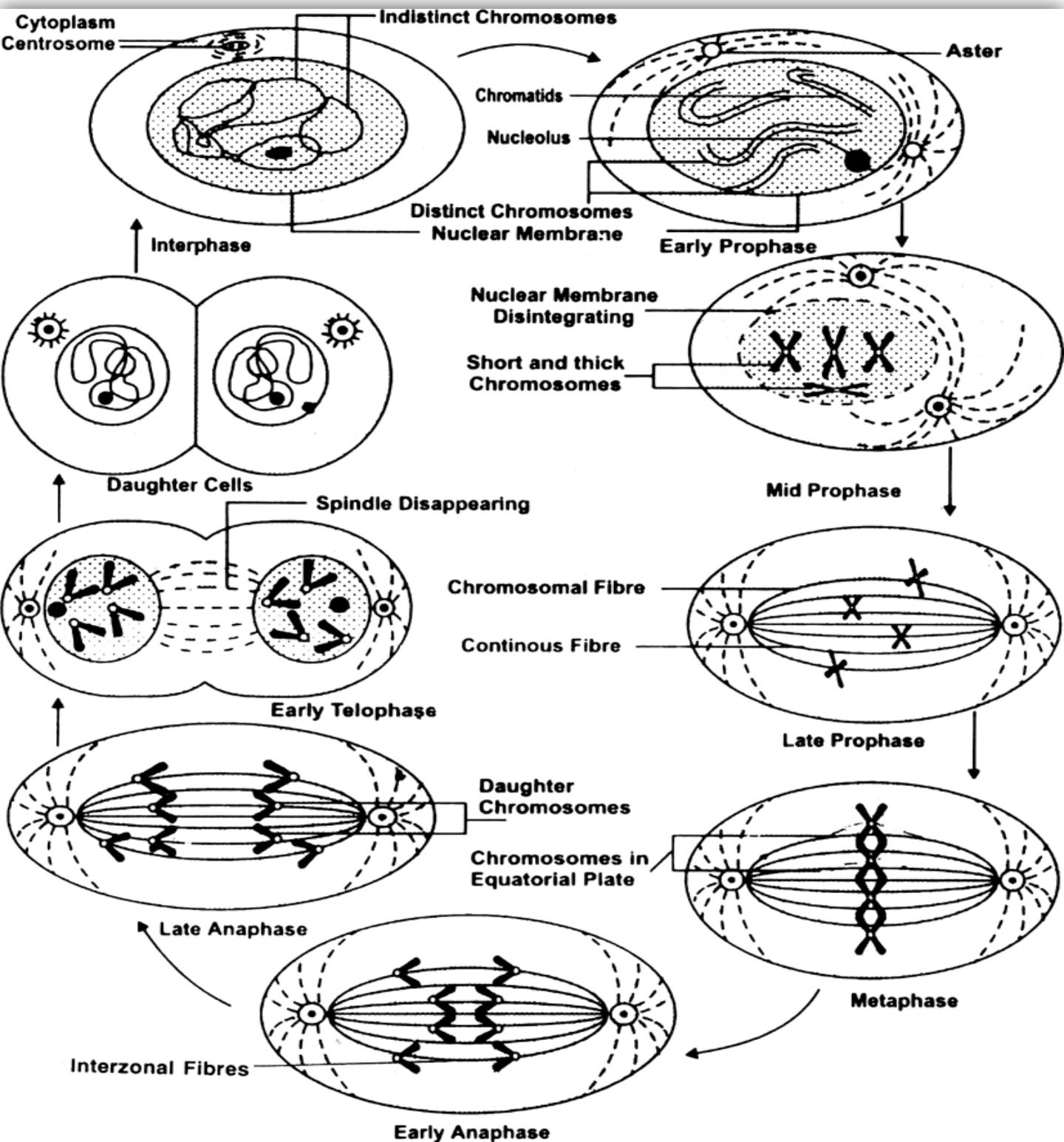
- METAPHASE:

- Each chromosome gets ATTACHED TO SPINDLE FIBRES by its CENTROMERE.
- Chromosomes arrange on the EQUATORIAL PLANE.

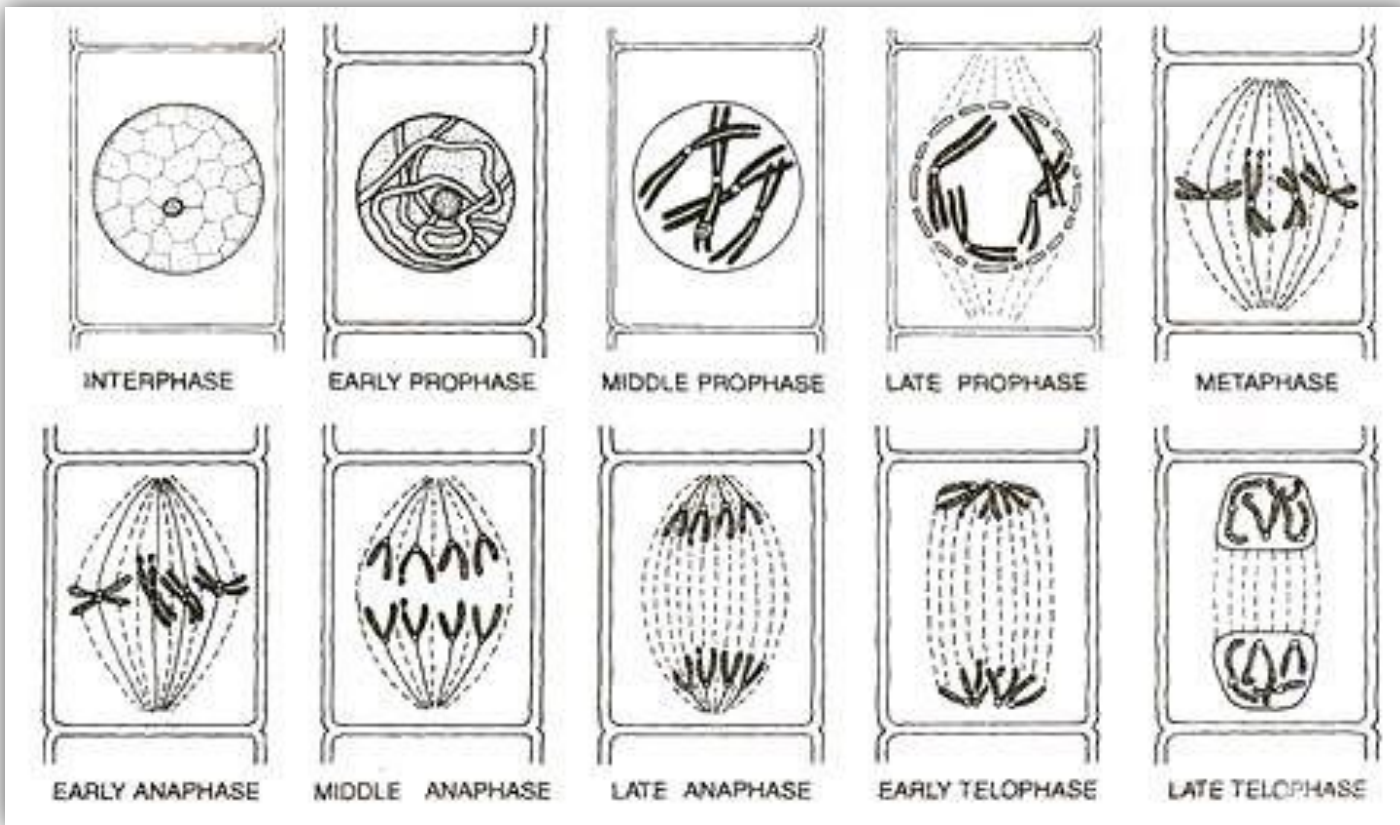
- **ANAPHASE:**
 - CENTROMERE attaching the two chromatids DIVIDES.
 - The TWO SISTER CHROMATIDS of each chromosome SEPARATE and are drawn apart TOWARDS OPPOSITE POLES pulled by shortening of spindle fibres.
 - A FURROW starts in the CELL MEMBRANE at the middle in the ANIMAL CELL.
 - This Is the shortest phase of mitosis.

- **TELOPHASE:**
 - Two sets of daughter chromosomes REACH OPPOSITE POLES.
 - Spindle fibres DISAPPEAR.
 - Chromatids thin out in the form of CHROMATIN FIBRES.
 - Nuclear membrane is formed.
 - The CLEAVAGE FURROW starts DEEPENING.
 - Nucleoli reappear.

- **CYTOKINESIS-** It means division of cytoplasm
- At the end of the TELOPHASE a furrow appears in the CELL MEMBRANE in the middle, which DEEPENS and finally SPLITS into two, thus PRODUCING TWO NEW CELLS.

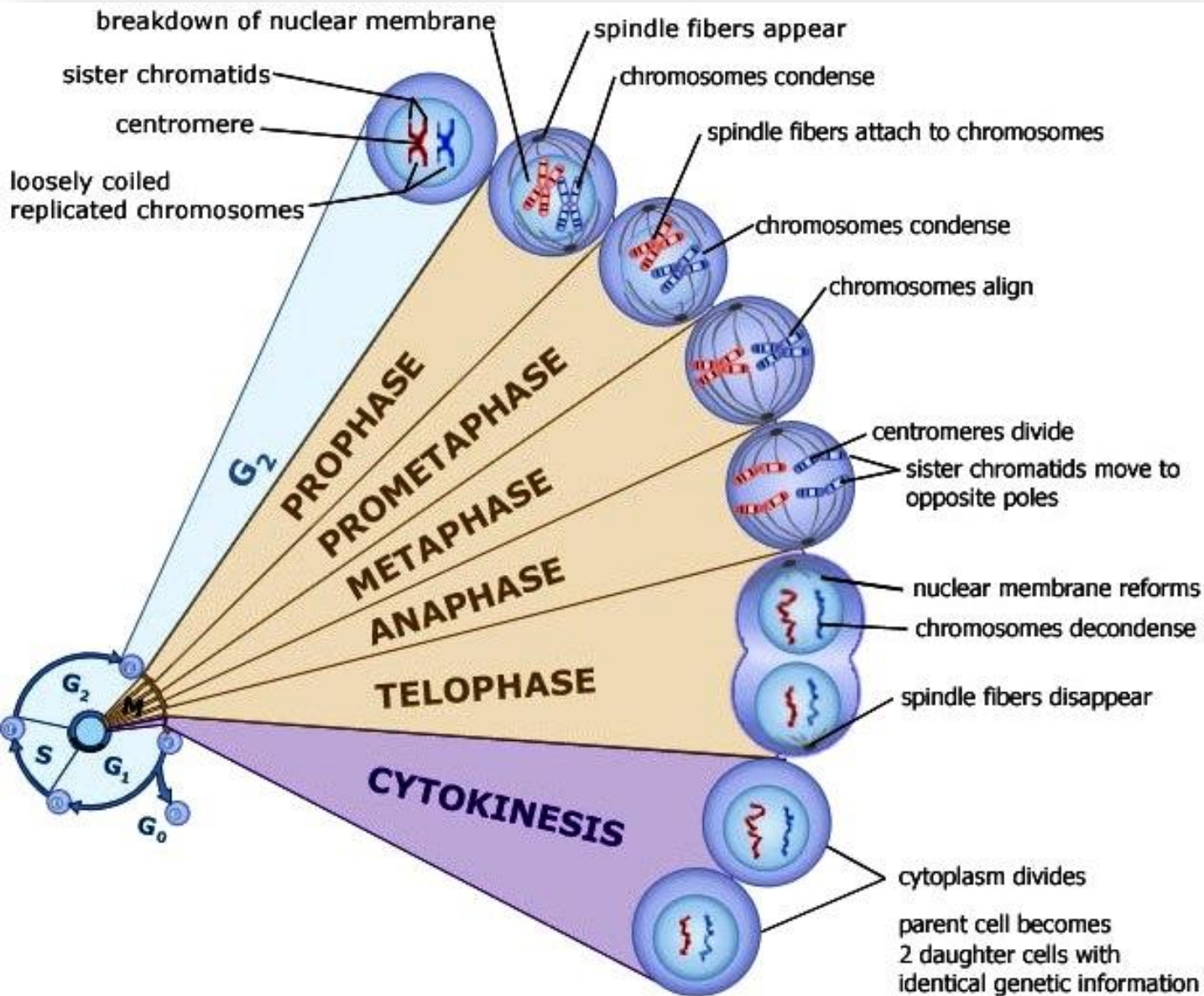


MITOSIS in animals (in a cell where chromosome number has been taken 4)



MITOSIS in Plants (in a cell where chromosome number has been take 4)

NOTE*: All the NUCLEAR changes that occur during the cell division are collectively termed as KARYOKINESIS, which is then followed by division of CYTOPLASM which is termed as CYTOKINESIS



CELL CYCLE:

G₁: GROWTH 1 PHASE

S: SYNTHESIS PHASE

G₂: GROWTH 2 PHASE

J) DIFFERENCE BETWEEN MITOSIS IN ANIMAL AND PLANT CELL :

Sr NO.	ANIMAL CELL	PLANT CELL
1.	<u>ASTERS</u> are formed (because <u>CENTRIOLES</u> are present)	<u>ASTERS</u> are not formed (because <u>CENTRIOLES</u> are absent)
2.	<u>CYTOKINESIS</u> by <u>FURROWING</u> of cytoplasm	<u>CYTOKINESIS</u> by <u>CELL PLATE</u> formation
3.	Occurs in <u>MOST TISSUES</u> throughout the <u>body</u> (for <u>growth and replacement</u>)	Occurs mainly at the <u>GROWING TIPS</u> (for <u>LENGTHENING</u>) and <u>SIDES</u> (for increase in <u>GIRTH</u>)

K) SIGNIFICANCE OF MITOSIS:

- 1) GROWTH or increase in the body size due to FORMATION OF NEW CELLS in the tissues.
- 2) REPAIR of damaged and wounded tissues by RENEWAL OF THE LOST CELLS.
- 3) REPLACEMENTS of the OLD AND DEAD cells
- 4) ASEXUAL REPRODUCTION
- 5) MAINTAINS SAME CHROMOSOME NUMBER IN DAUGHTER CELLS.

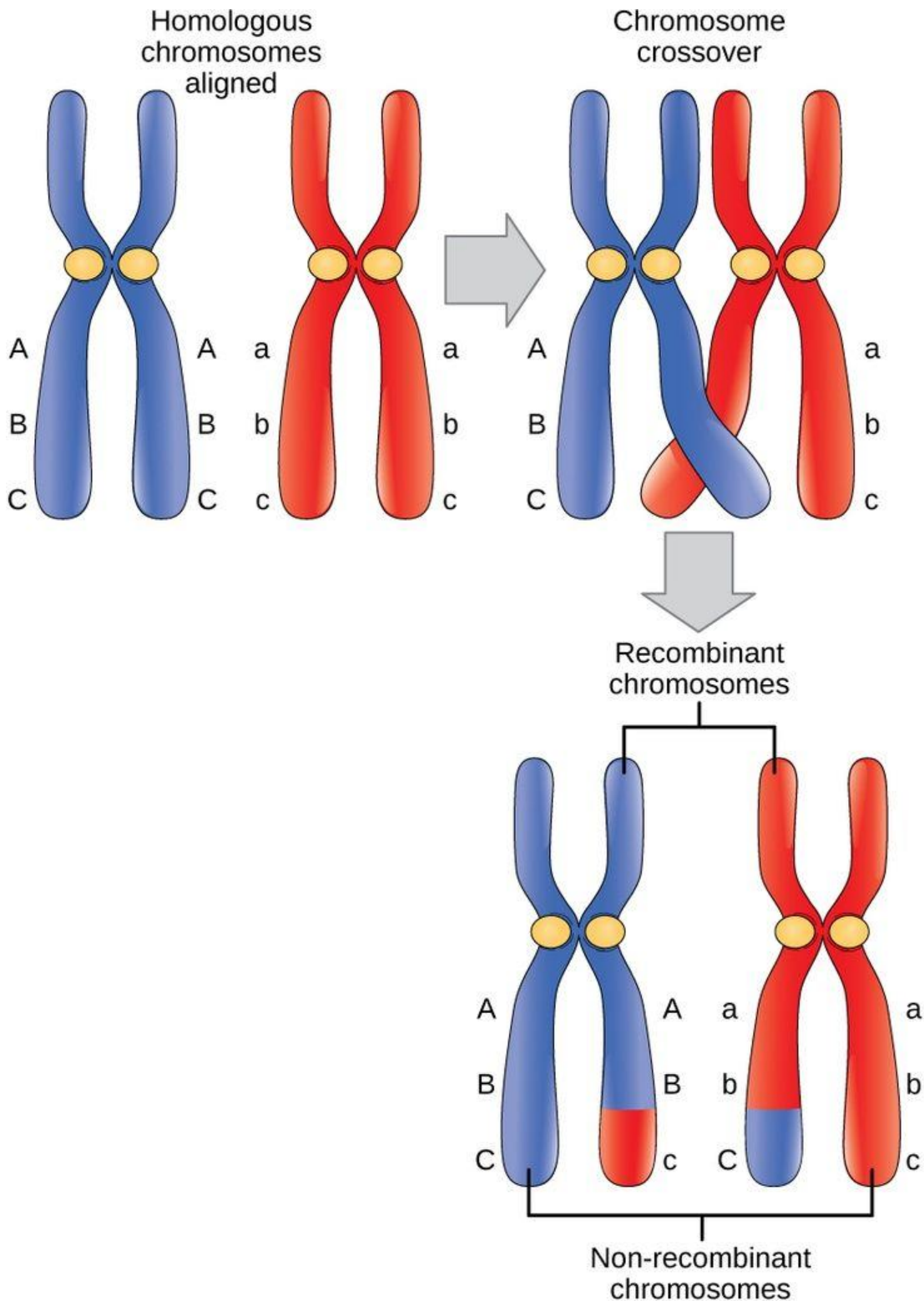
NOTE*: The last point is the most important point and many conceptual questions are based on this point.

L) MEIOSIS:

- 1) DEFINITION: MEIOSIS IS THE TYPE OF CELL DIVISION LEADING TO THE PRODUCTION OF HAPLOID CELLS FOR REPRODUCTION.
- 2) This type of cell division produces SEX CELLS OR THE GAMETES.
- 3) The most significant aspect of meiosis is that NUMBER OF CHROMOSOMES in the SEX CELLS IS HALVED.

M) SIGNIFICANCE OF MEIOSIS:

- 1) CHROMOSOME NUMBER IS HALVED in the gametes, so that on fertilization, THE NORMAL NUMBER OF CHROMOSOMES(2n) is restored.
- 2) It provides for mixing up of genes which occur in two ways:
 - THE MATERNAL AND PATERNAL CHROMOSOMES get mixed up during the first division as they separate from the homologous pairs
 - While the maternal and paternal chromosomes are separating, the chromatid material very often gets exchanged between the two members of a homologous pair. This is known as CROSSING OVER which results in GENETIC RECOMBINATION. (the definition of genetic recombination is same as that of crossing over)



CROSSING OVER between MATERNAL AND PATERNAL CHROMATIDS during meiosis to produce a new combination of genes

Sr No.		Mitosis	Meiosis
1.	Where it occurs	<u>Somatic</u> cells	<u>Reproductive</u> cells
2.	What for	<u>Growth and replacement</u>	<u>Gamete formation</u>
3.	When it occurs	<u>Throughout life</u>	<u>Reproductively active age</u>
4.	Number of daughter cells produced	<u>Two</u> daughter cells	<u>Four</u> daughter cells
5.	Number of chromosomes passed to each daughter cells	<u>Full set of chromosomes</u> is passed on. This is the <u>diploid</u> number of chromosomes	Only <u>half number of chromosomes</u> is passed on. This is the <u>haploid</u> number of chromosomes
6.	Number of nuclear division	A <u>single</u> nuclear division	<u>Two</u> nuclear division
7.	Identity of chromosomes and gametes in daughter cell	<u>Identical</u>	<u>Randomly assorted</u> between the gametes produced which results in genetic recombination

QUESTIONS:**A) NAME THE FOLLOWING:**

- 1) The complex structure of DNA and histones
- 2) The rays with a centriole
- 3) Cells which divide by meiosis
- 4) A thread like strand formed from a chromatin during the early stages of cell division
- 5) The phase when DNA replication takes place
- 6) An active phase of growth and synthetic activity in the cell
- 7) The stage where nuclear membrane and nucleolus reappear
- 8) The shortest phase of mitosis
- 9) The point at which the duplicated chromosomes are joined
- 10) The structure which initiates cell division in animal cells
- 11) The largest phase of a normal cell cycle.

B) STATE WHETHER THE FOLLOWING STATEMENTS ARE TRUE OR FALSE AND CORRECT THE FALSE STATEMENT:

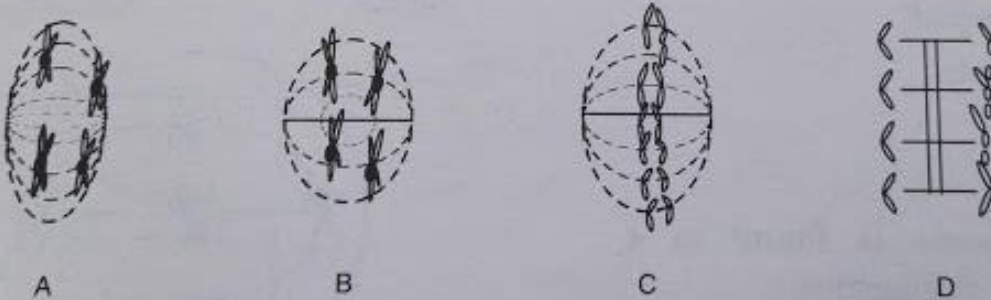
- 1) Four daughter cells are formed as a result of meiosis
- 2) Karyokinesis refers to the division of nucleus
- 3) In mitosis prophase is of short duration
- 4) RNA contains thymine
- 5) Mitotic cell division can be mode of reproduction
- 6) Cytosine is the nitrogenous base that pairs with adenine in DNA molecule

C) Differentiate between:

- 1) Mitosis and Meiosis
- 2) Centrosome and Centromere

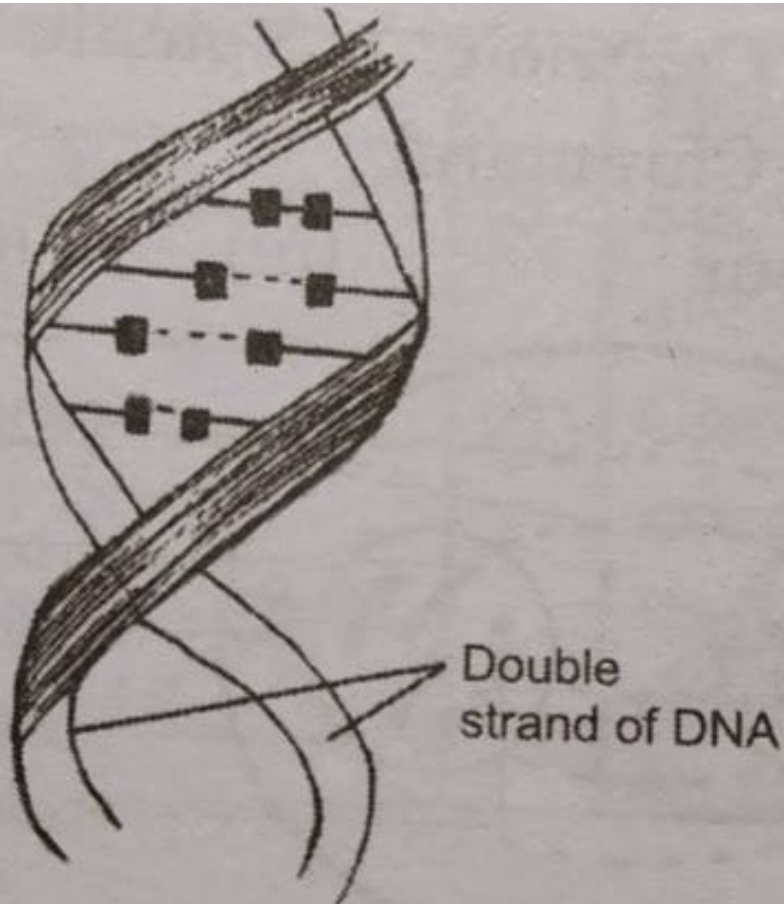
D) DIAGRAM QUESTIONS:

1) Given below are four diagrams which indicate four stages of cell division in a living cell



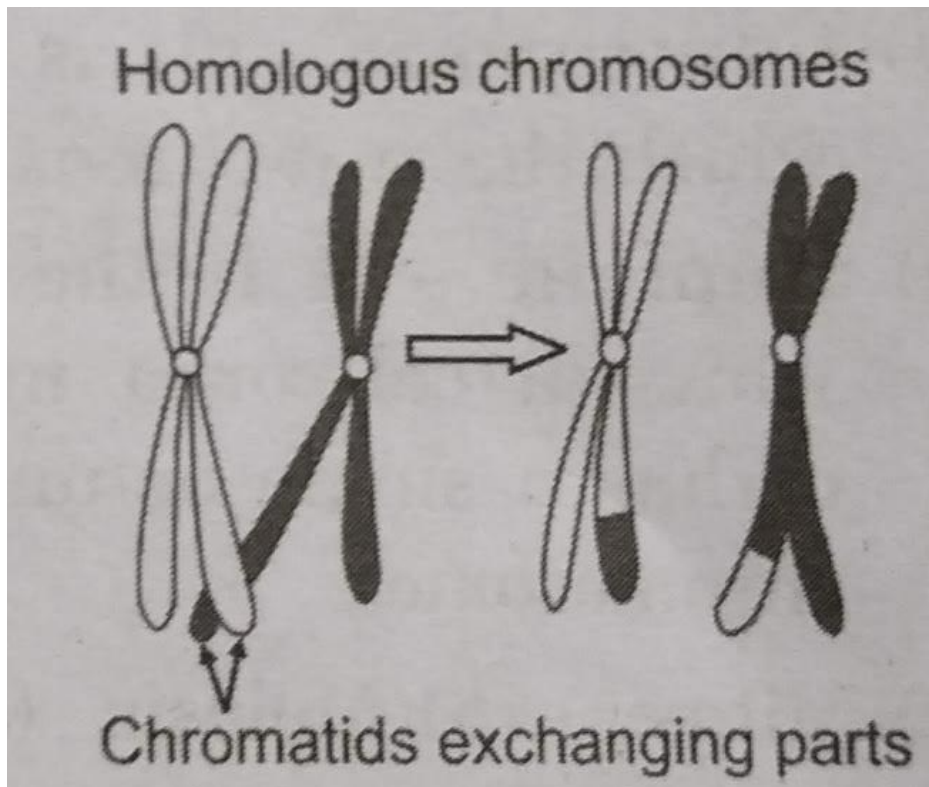
- Name the type of cell division
- Define the type of cell division
- What is the significance of the above cell division
- Where does the above cell division take place
- How many chromosomes are present in the above diagrams
- Is it a plant cell or animal cell
- Give reason for above

2) There is a diagram of a double helical structure of DNA:



- a) Name the four nitrogenous bases that form a DNA molecule
- b) Give the full form of DNA
- c) Name the unit of heredity

- 3) The given figure represents a certain phenomenon that occurs during meiosis:



- Name the phenomenon
- Define the phenomenon
- State the difference between chromosomes and chromatids

ANSWERS:**A) NAME THE FOLLOWING:**

- 1) Nucleosome
- 2) Asters
- 3) Reproductive cells
- 4) Chromosomes
- 5) Synthesis Phase
- 6) Interphase
- 7) Telophase
- 8) Anaphase
- 9) Centromere
- 10) Centrosome
- 11) Prophase

B) STATE WHETHER THE FOLLOWING STATEMENTS ARE TRUE OR FALSE AND CORRECT THE FALSE STATEMENT:

- 1) True
- 2) True
- 3) False

Correct statement : In mitosis ANAPHASE is of short duration

- 4) False

Correct statement: DNA contains Thymine

5) False

Correct statement : Meiotic cell division can be mode of reproduction

6) False

Correct statement: Cytosine is the nitrogenous base that pairs with guanine in DA molecule.

OR

Thymine is the nitrogenous base that pairs with adenine in DA molecule.

C) Differentiate between:

1)

Sr NO.	Mitosis	Meiosis
1.	Tow daughter cells are formed	Four daughter cells are formed
2.	Only one division occurs	Two division occurs

2)

Sr NO.	Centrosome	Centromere
1.	It is an organelle of the animal cell	It is a part of chromosome where two sister chromatids join
2.	It contains two centrioles which serves to form spindle fibres during cell division	It provides site for attachment of spindle fibres during cell division

D) DIAGRAM QUESTIONS:

1)

a) Mitosis

b) Mitosis is the type of cell division leading to the production of diploid cells for growth and development.

c) This type of cell division maintains the same number of chromosome in daughter cells

d) Somatic cells of the body

e) Four chromosomes

f) Plant cell

g) Centrosomes along with their centrioles are absent and hence it is a plant cell

2)

- a) Adenine, Thymine, Guanine, Cytosine
- b) Deoxyribonucleic Acid
- c) Genes

3)

- a) Crossing Over
- b) While the maternal and paternal chromosomes are separating, the chromatid material very often gets exchanged between the two members of a homologous pair. This is known as crossing over.
- c) Chromosomes are the carriers of heredity while chromatids are the two identical strands of a duplicated chromosomes.

YOUTUBE- [ICSE StudyMate](#)

Founder's Message

Hey there!

Firstly, we are glad you are here with us at ICSE StudyMate. I founded ICSE StudyMate in 2018 with the sole purpose of helping students. I was really lucky to find many more people who had the same vision and now we all work together towards this common goal. Thank you for believing in us and we promise to help you at each step in this journey of yours. Good luck with your preparation and remember ICSE, it's easy!



Aditi Agrawal

ICSE student, Batch of 2018

If you want to contact me personally,

Email- aditi@icsestudymate.com

Instagram- [@icsestudymate](https://www.instagram.com/icsestudymate)

Author's Message

Hello friends, I am Monisha Gupta and I aspire to be a good content creator, a great CA and a resourceful senior to my fellow juniors :) I am an 11th grade commerce student and I scored 94 % in ICSE 2020 examination. I truly understand the challenges of wading through the deep and vast curriculum of ICSE and I would love to share whatever I have learnt so far to help you reach your goals. Feel free to reach out to me at @_._.monisha_._. Good luck for your preparation!

Students' Messages

Your ig page is amazing like to see all icse student meet at a common page and your revisions concept and tests are amazing keep this growing you also help students with every doubt they have which is incredible thanks a lot from me and all icse students
Parth Rastogi



~ Parth Rastogi, 99.6 %

Bro/sis thank you so much for all the help you've given me! I found this page just a couple of weeks before my boards and all the timetables have been of great help to me! Thanks again



Kevin, 98.8%



Thanks a lot for your help. The tips from this page helped a lot and it gave me the much needed confidence and boost when I was tensed during my boards.
I got 96.2% and this page was one of the reasons why.

Plus this page was a major stress buster and the memes are quite fun. The fact that I got extremely quick replies and a beautifully crafted answer helped a lot



Thankssss💕

~Mariam Khan, 96.2%

The journey was absolutely amazing , the best here was the guidance you gave us . This was the need of the hour where we needed a helping hand to clear our doubts , help us and make us believe in ourselves and you guys did it perfectly! Thank you very much! The credits of our results goes to you too! Thank you so much🙏



For more check out [Testimonials](#)