CHANDIGARH UNIVERSITY

Discover. Learn. Empower.

UNIVERSITY INSTITUTE OF SCIENCES

DIVISION CHEMISTRY

Bachelor of Engineering (Computer Science & Engineering)

Biology For Engineers -20SZT148

Living Organisms and cell theory

By Shruti Sharma

DISCOVER . LEARN . EMPOWER

CELL DIVISION AND DIFFERENTIATION

Course Objective

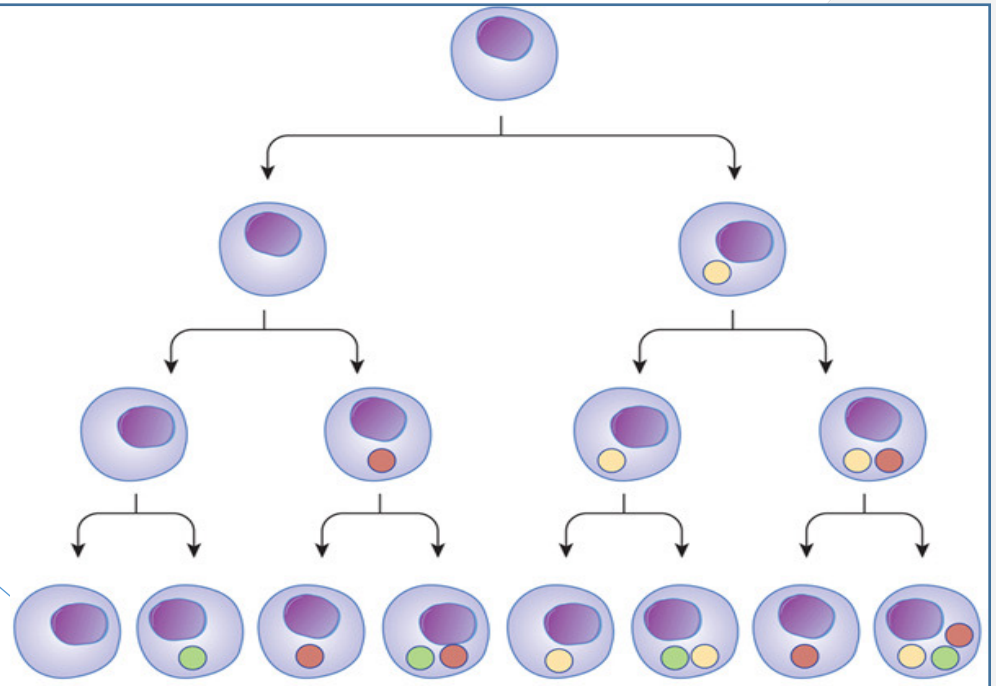
- This subject is designed to impart fundamental knowledge on basic and emerging fields of biology like bioinformatics.
- It is designed to impart knowledge that how to apply basics of biology in engineering.

https://www.basicknowledge101.com/photos/2016/biology_sketches.jpg

CELL DIVISION AND DIFFERENTIATION

Course Outcome

CO Number	Title	Level
CO1	To develop the firm foundation in science principles and higher level of understanding in each of the biology sub-discipline.	**Remember**
CO2	To excel in career as researcher in both traditional and emerging fields of science .	**Understand**
CO3	Understand ethical principles and responsibilities for science practices in society.	Understand
CO4	To learn the new areas of biology for contemporary research with interdisciplinary approach	Understand



Will be covered in this lecture

https://www.nature.com/scitable/content/ne0000/ne0000/ne0000/ne0000/14707620/U2CP3-4B_RegulProteinsLoop_ksm.jpg

CELL CYCLE

Cell cycle- It is a series of changes that occur in newly formed cell during growth and division to form two daughter cell.

Consist of three steps-

- Interphase (I Phase),
- Karyokinesis (M Phase),
- Cytokinesis (D Phase)

CELL CYCLE

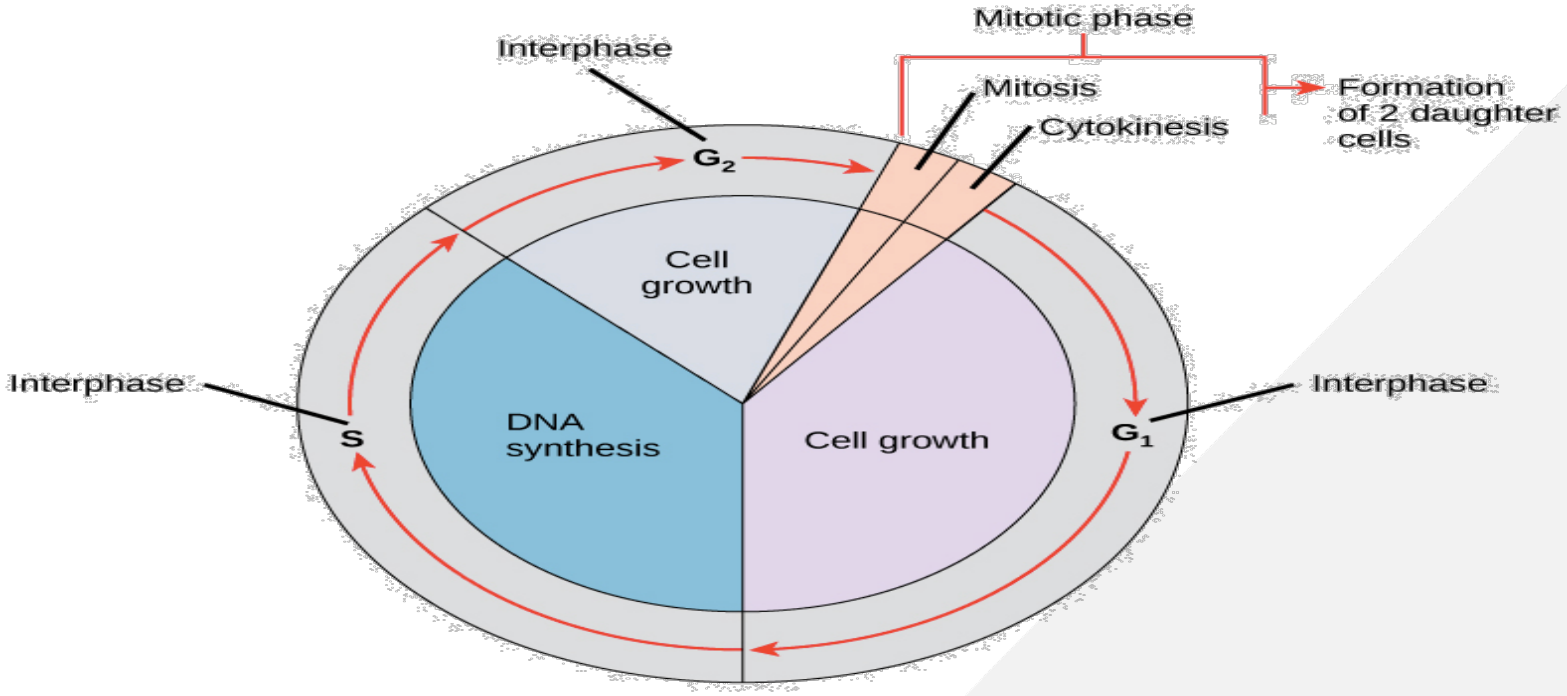


Fig.1.1: Cell cycle

https://cdn.kastatic.org/ka-perseus-images/6afac0fce62ec8a30c86f3e02c457224339bb697.png

WHY CELL DIVISION REQUIRED?

- Cell growth.
- Repair & replacement of damaged cell parts or old cells.
- Reproduction of the species.

INTERPHASE

- It is also called preparatory phase or intermitosis.
- Typically interphase lasts for at least 91% of the total time required for the cell cycle.
- Interphase proceeds in three stages,
- G1
- S
- G2 followed by the cycle of mitosis and cytokinesis.

G1 PHASE

- To continue cell cycle and enter S phase
- Stop cell cycle and enter G0 phase for undergoing differentiation.
- Become arrested in G1 phase hence it may enter G0 phase or re-enter cell cycle.
- The deciding point is called check point (Restriction point) and is regulated by G1/S cyclin, which cause transition from G1 to S phase.
- Passage through the G1 check point commits the cell to division.

S PHASE

S phase (DNA replication)

- The ensuing S phase starts when DNA synthesis commences; when it is complete, all of the chromosomes have been replicated.
- Thus, during this phase, the amount of DNA in the cell has doubled, though the ploidy and number of chromosomes are unchanged.
- Rates of RNA transcription and protein synthesis are very low during this phase.
- An exception to this is histone production, most of which occurs during the S phase.

G2 PHASE

- G2 phase occurs after DNA replication and is a period of protein synthesis and rapid cell growth to prepare the cell for mitosis.
- Before proceeding to mitotic phase, cells must be checked at the G2checkpoint for any DNA damage within the chromosomes.
- The G2 checkpoint is mainly regulated by the tumor protein p53.
- If the DNA is damaged, p53 will either repair the DNA or trigger the apoptosis of the cell.

QUESTIONS FOR POLLING

Phases of Interphase

1. G1
2. S
3. G2
4. All of the above

MITOSIS

Mitosis- A type of cell division that results in two daughter cells each having the same number and kind of chromosomes as the parent nucleus, typical of ordinary tissue growth.

Phases of Mitosis

- Prophase
- Metaphase
- Anaphase
- Telophase

PHASES OF MITOSIS

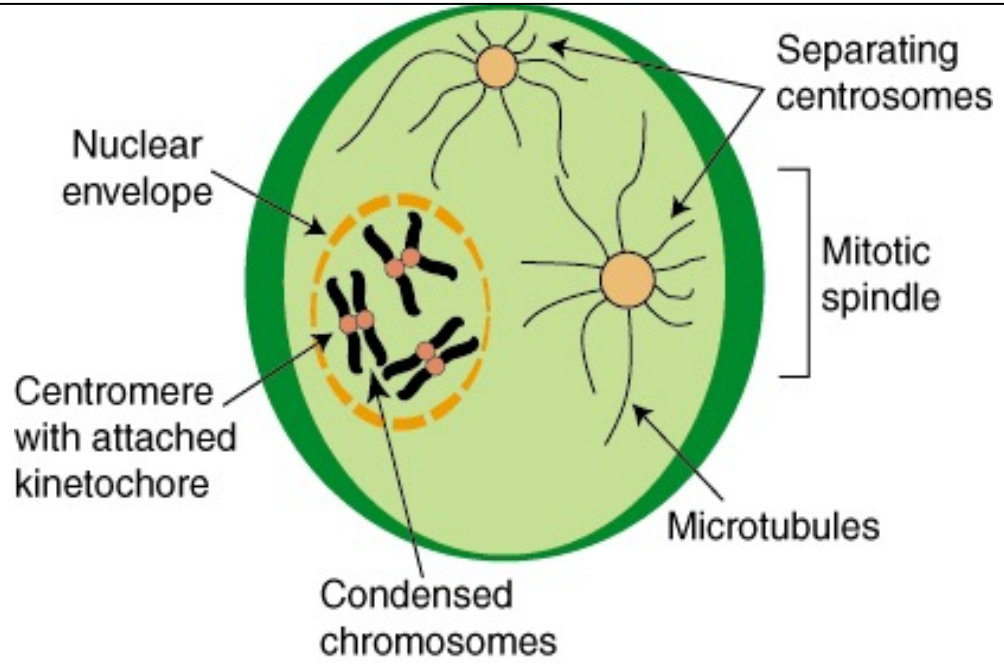


Fig.1.2: Prophase

https://img.sparknotes.com/figures/D/d756b5b73abe2974f3521a828791899f/prophase.gif

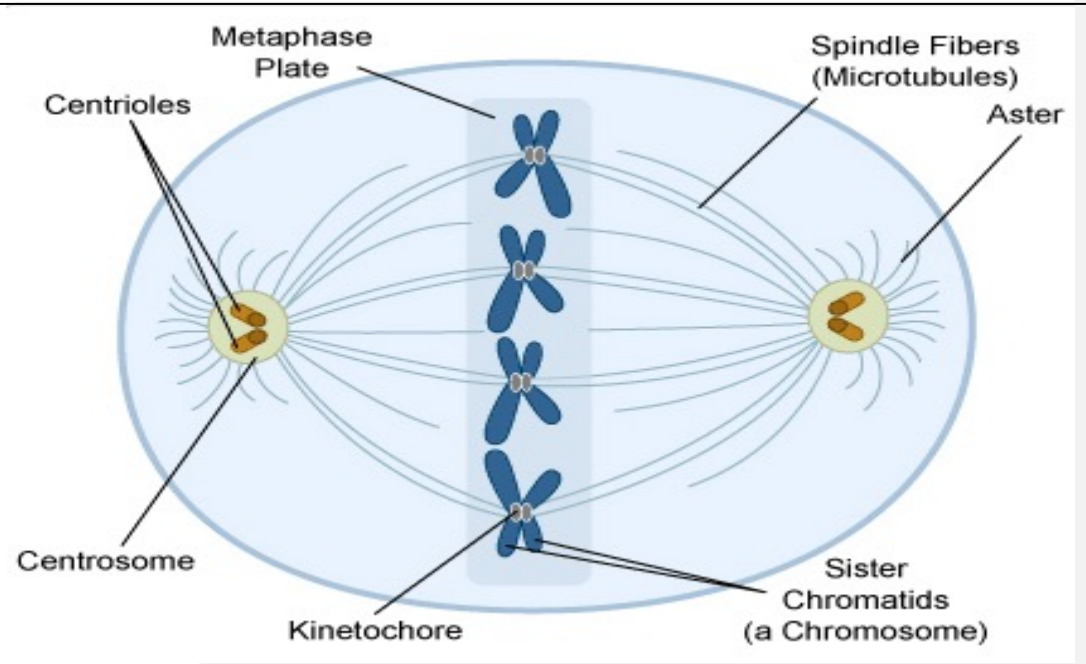


Fig.1.3: Metaphase

https://haygot.s3.amazonaws.com/questions/651384_392485_ans_4ec6581827ae49df947b8fbda7ac0683.PNG

PHASES OF MITOSIS

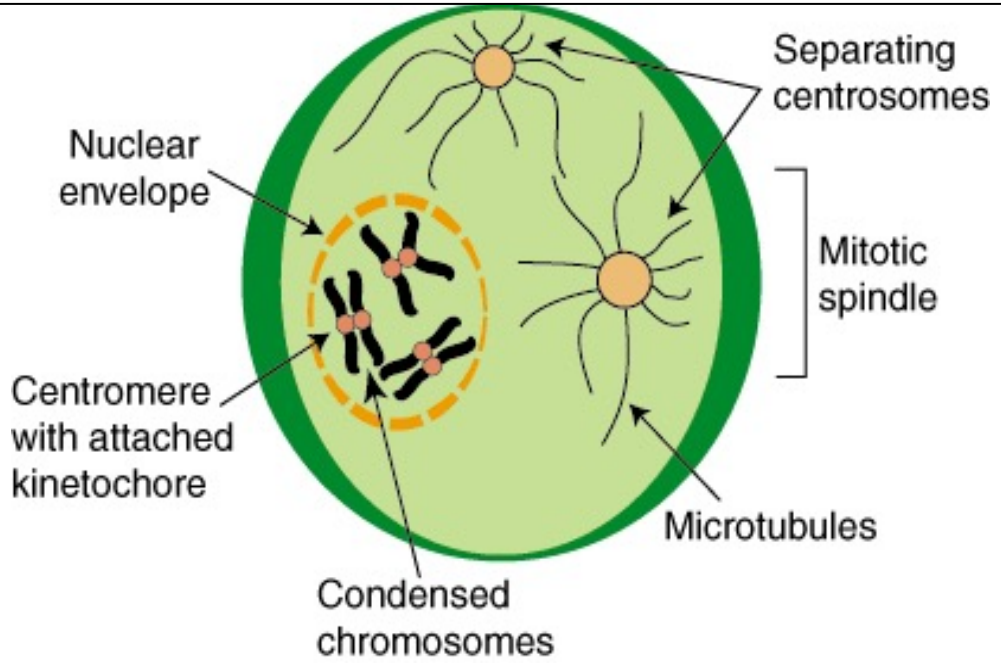


Fig.1.2: Prophase

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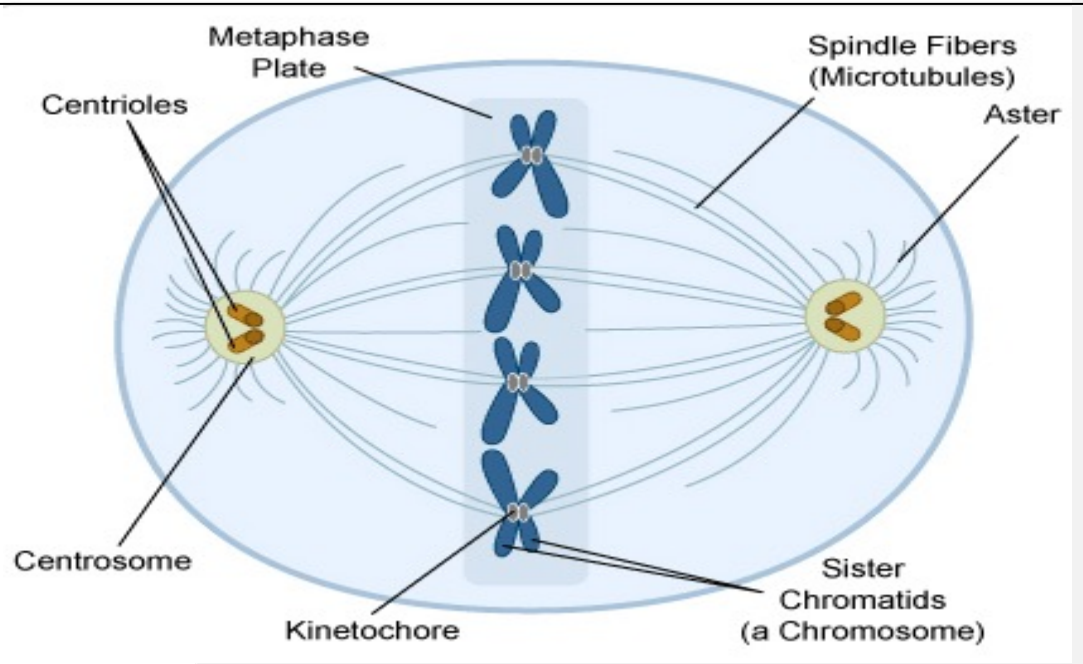

Fig.1.3: Metaphase

https://haygot.s3.amazonaws.com/questions/651384_392485_ans_4ec6581827ae49df947b8fbda7ac0683.PNG

KINETOCHORE

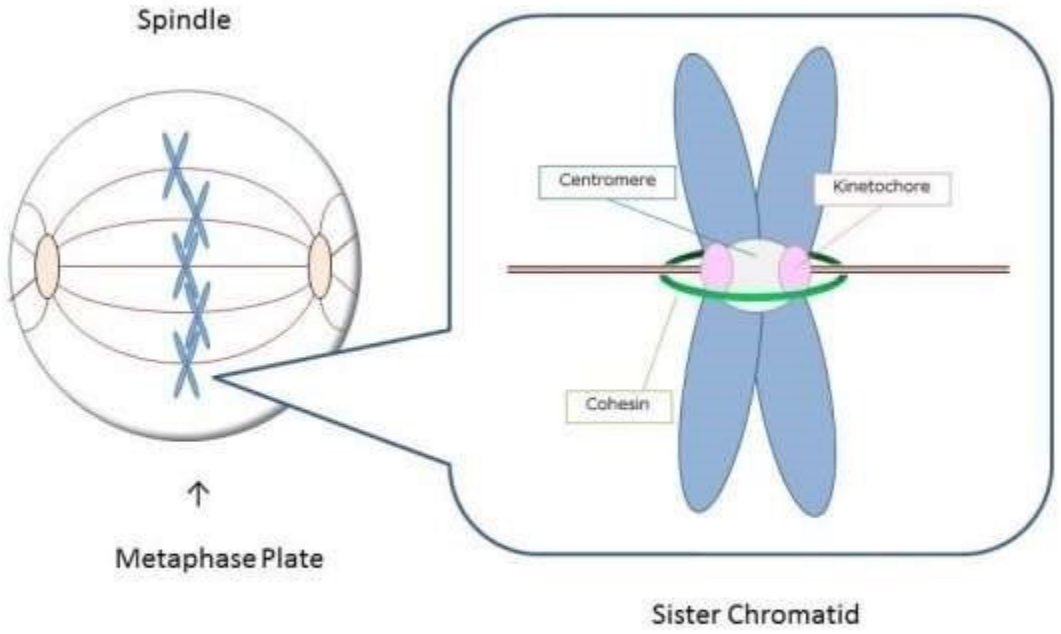

Fig 1.3 Kinetochore
https://scx1.b-cdn.net/csz/news/800/2019/1-hownewlyfoun.jpg

PHASES OF MITOSIS

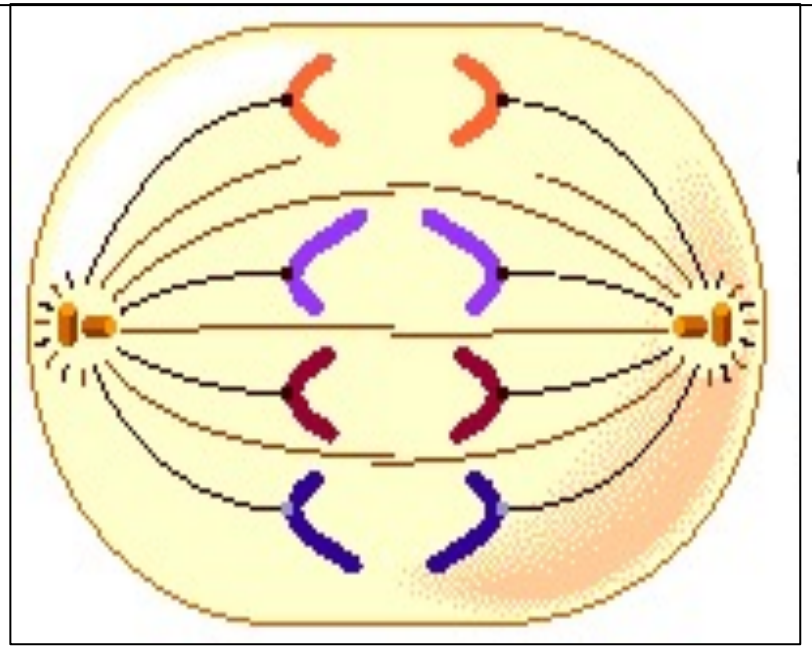

Fig.1.4: Anaphase

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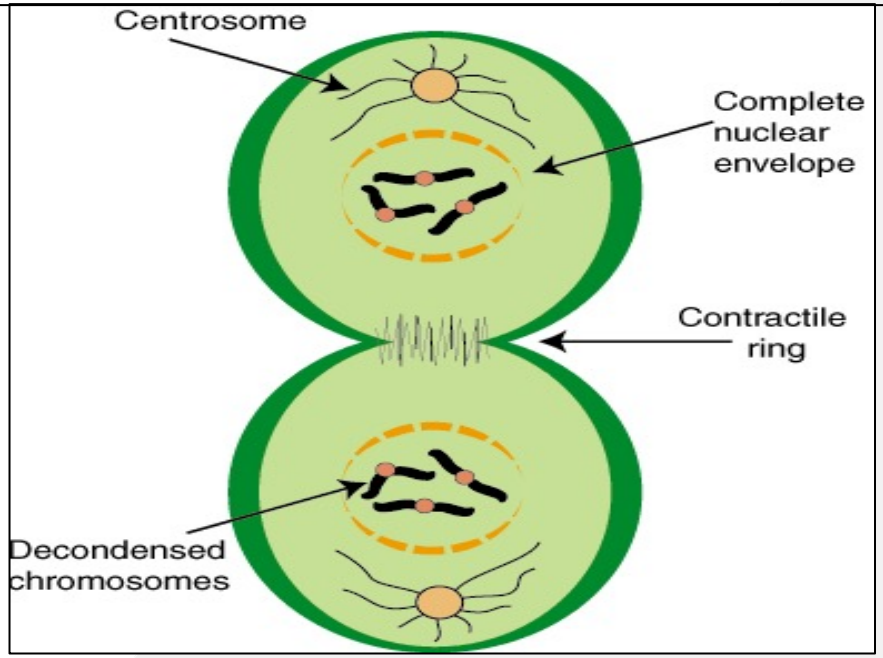

Fig.1.5 Telophase and cytokinesis

https://img.sparknotes.com/figures/D/d756b5b73abe2974f3521a828791899f/cytokinesis.gif

MITOSIS

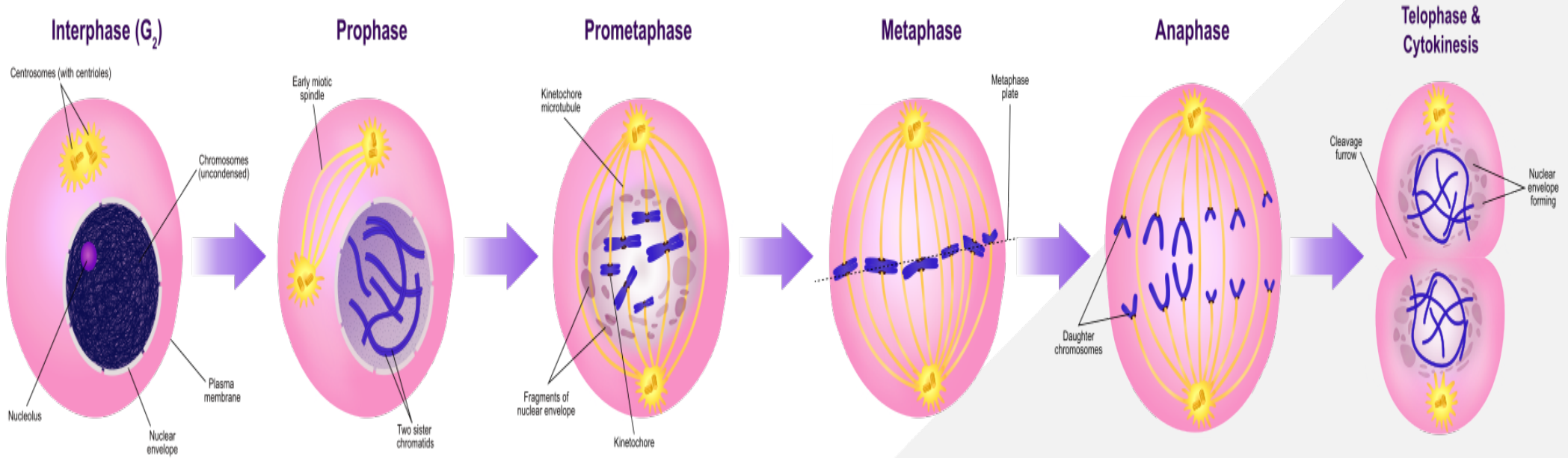

Fig 1.6 Mitosis
https://upload.wikimedia.org/wikipedia/commons/thumb/c/c9/Mitosis_Stages.svg/1920px-Mitosis_Stages.svg.png

FUNCTIONS

- Development and growth
- Cell replacement
- In like manner, red blood cells have a short lifespan (only about 4 months) and new RBCs are formed by mitosis.
- Regeneration
- Asexual reproduction

SIGNIFICANCE

- Mitosis is responsible for the development of the zygote into an adult.
- The chromosomes are distributed equally to the daughter cells after each cycle.
- It is responsible for a definite shape, and proper growth and development of an individual.
- It maintains the constant number of chromosomes in all body cells of an organism.
- In plants, mitosis helps in the formation of new parts and the repairing of damaged parts. Mitosis helps in vegetative propagation of crops also.
- Since no recombination and segregation occurs in the process, it helps in maintaining the purity of types.
- It helps in maintaining a balance between the DNA and RNA contents as well the nuclear and cytoplasmic contents of the cell.
- It is responsible for replacing dead and old cells in the animals: Eg., gut epithelium, and blood cells.

CELL DIFFERENTIATION

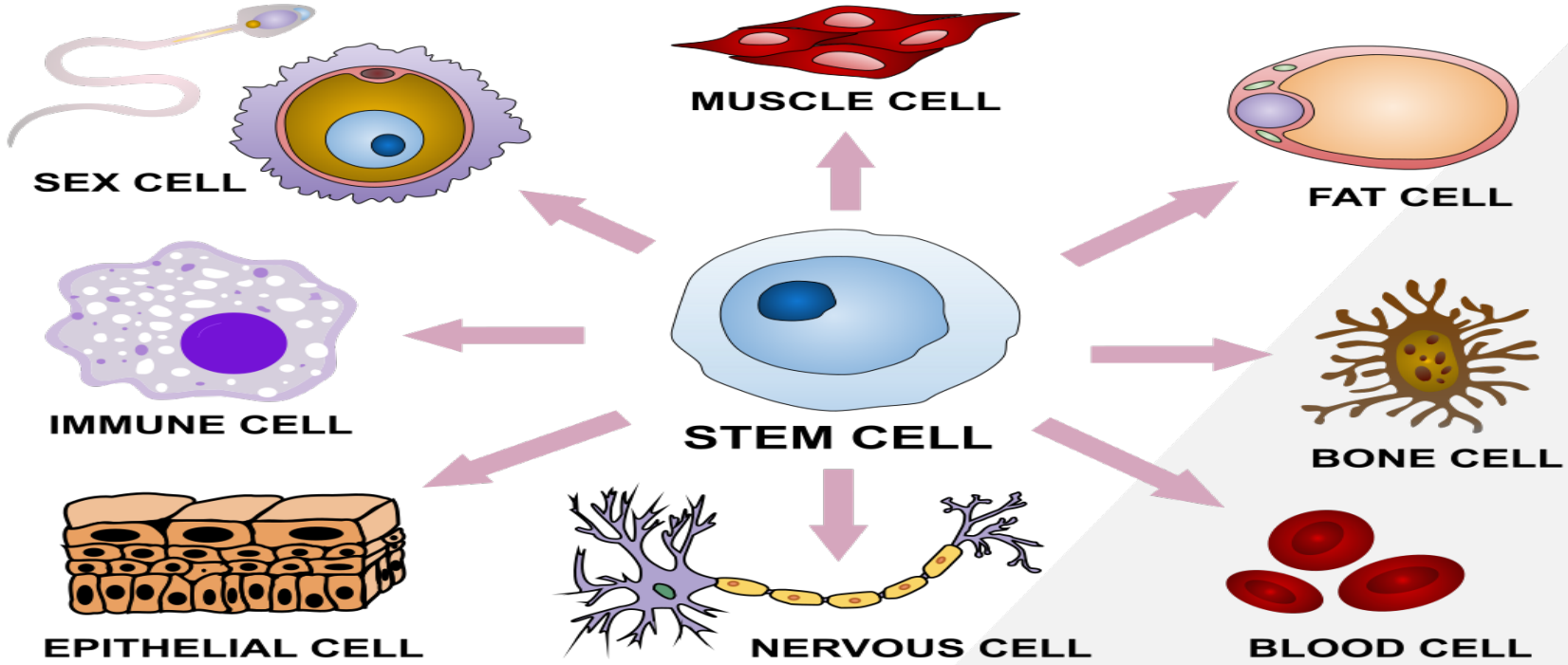

Fig.1.9: Process of cell differentiation

https://upload.wikimedia.org/wikipedia/commons/thumb/d/d3/Final_stem_cell_differentiation_%281%29.svg/1200px-Final_stem_cell_differentiation_%281%29.svg.png

CONCLUSION

- Cell division is required for cell growth, repair, replacement and reproduction.
- Cell division is of two types:
- Mitosis and
- Meiosis

Cell differentiation

HOME WORK

Q.1. Nuclear DNA replicates in the _____ phase.

a) G2 phase

b) M phase

c) S phase

d) None of the above

Q2. Draw a well labelled diagram of cell cycle.

APPLICATIONS

- The study of cell division will pave way for advance studies in cell biology.
- The study of cell division help in understanding the how cell repair and reproduce.
- The study of cell division help in applying the knowledge of cell division in higher education.

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3. https://en.wikipedia.org/wiki/Cell_division#:~:text=Cell%20division%20is%20the%20process,of%20a%20larger%20cell%20cycle.
4. https://www.khanacademy.org/science/biology/cellular-molecular-biology
5. https://www.youtube.com/watch?v=NFdeXi9Gfpc
6. http://www.digimat.in/nptel/courses/video/121106008/L13.html
7. https://youtu.be/xsrH050wnIA

THANK YOU

For queries
Email:
shruti.e8736@cumail.in