



**CHANDIGARH
UNIVERSITY**

Discover. Learn. Empower.

UNIVERSITY INSTITUTE OF SCIENCES

DIVISION ACADEMIC UNIT 1

Bachelor of Engineering (Computer Science & Engineering)
Biology For Engineers -20SZT148



Cell Division

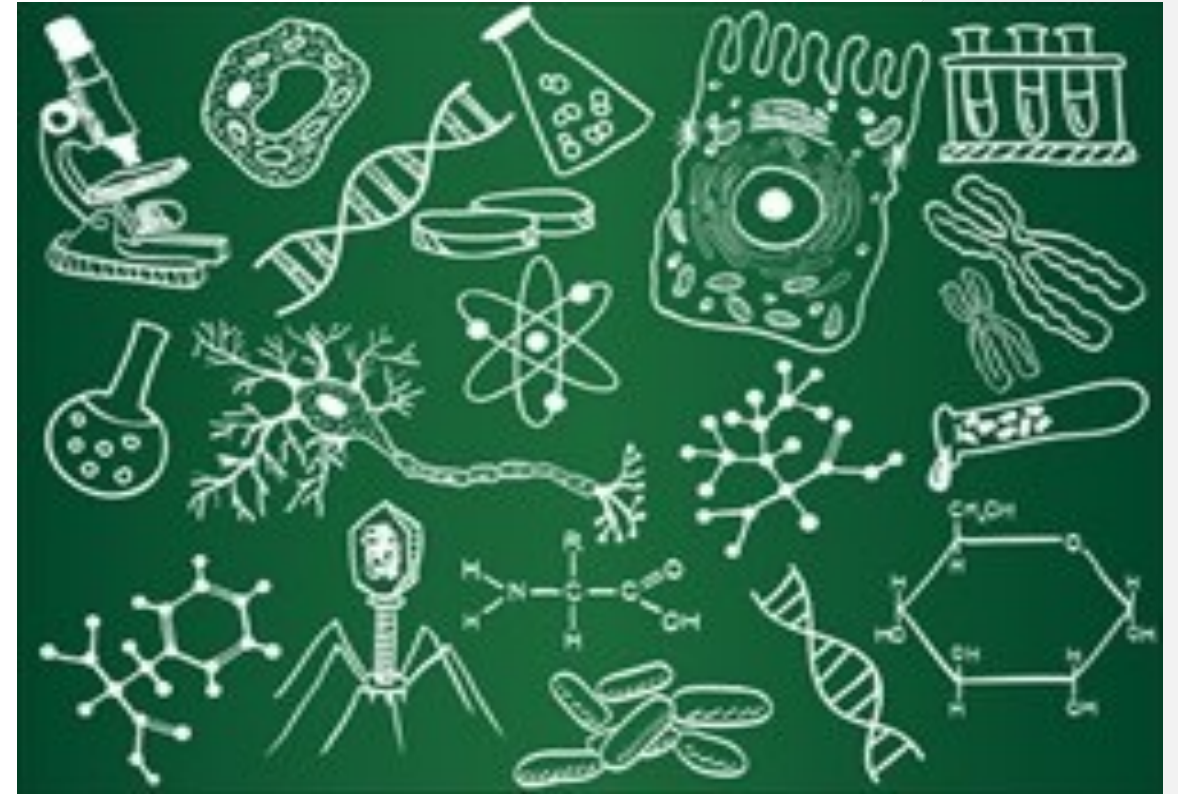
By Shruti Sharma

DISCOVER . **LEARN** . EMPOWER

CELL DIVISION MEIOSIS

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.

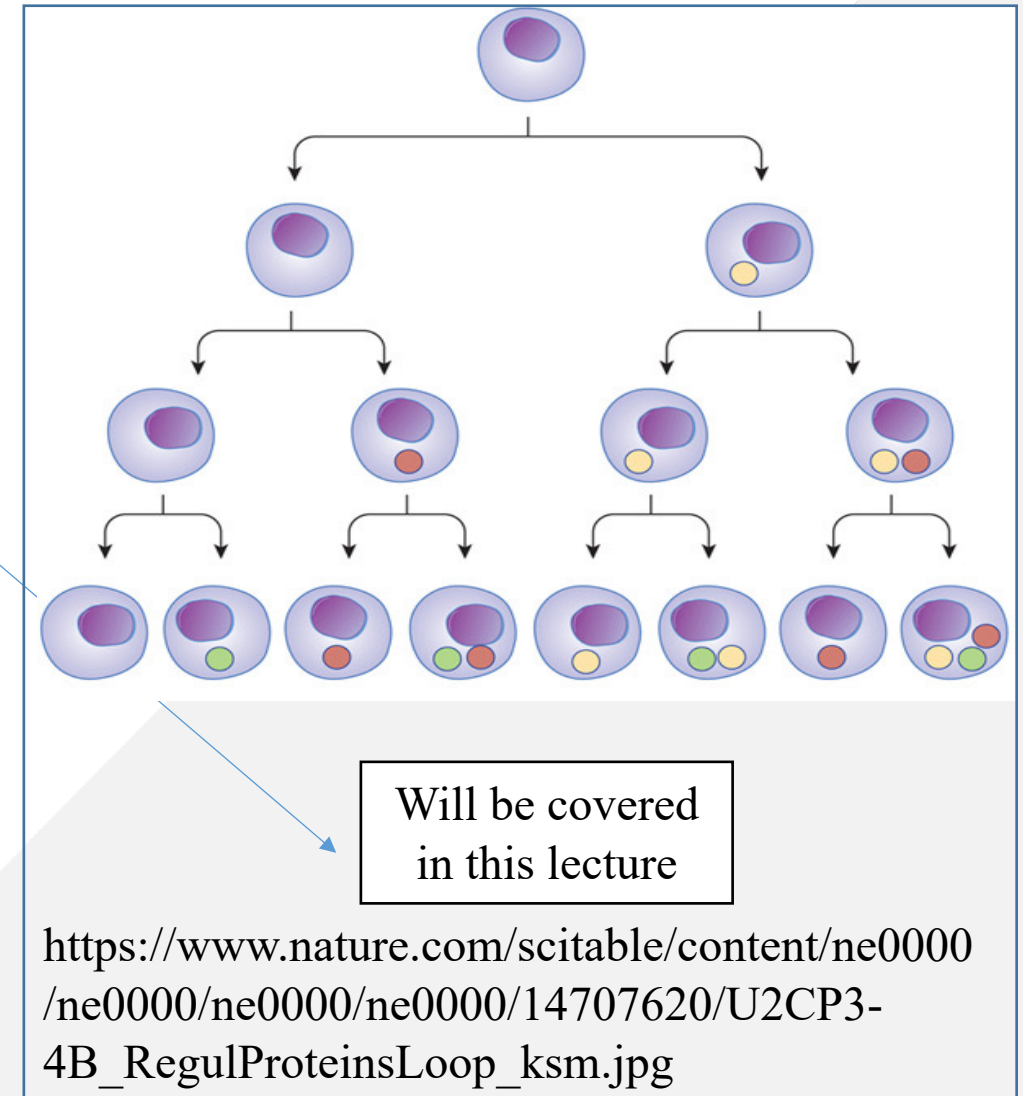


https://www.basicknowledge101.com/photos/2016/biology_sketches.jpg

CELL DIVISION MEIOSIS

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



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

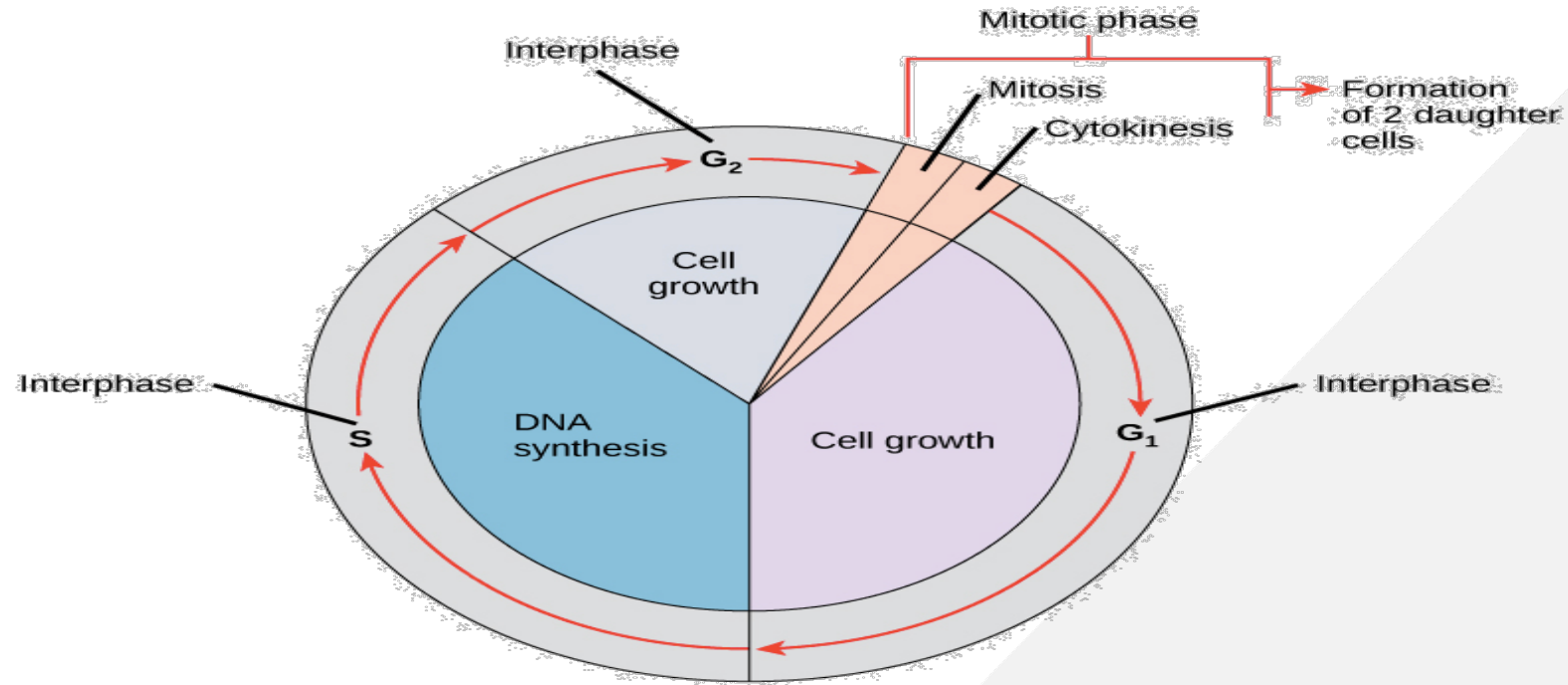


Fig.1.1: Cell cycle

<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.

CELL DIVISION

Cell division is the process by which a parent cell divides into two or more daughter cells.

It is of two type:

1. Mitosis- Division take place in somatic cells
2. Meiosis- Division take place in reproductive cell

Meiosis

Meiosis is a double division which occurs in a diploid cell and give rise to four haploid cells each having half the number of chromosomes as compared to the parent cells.

Two divisions:

- Meiosis I and
- Meiosis II

Meiosis I

Mitotic cell division is equational in nature while meiosis is a reduction division. The salient features of meiotic division that make it different from mitosis are as follows:-

- It occurs in two stages of the nuclear and cellular division as Meiosis I and Meiosis II. DNA replication occurs, however, only once.
- It involves the pairing of homologous chromosomes and recombination between them.
- Four haploid daughter cells are produced at the end, unlike two diploid daughter cells in mitosis.

Meiosis I

- Meiosis 1 Prophase 1
- Prophase I is longer than the mitotic prophase and is further subdivided into 5 substages,
- leptotene
- zygotene
- pachytene
- diplotene
- diakinesis

Meiosis I

- The chromosomes begin to condense and attain a compact structure during **leptotene**.
- In **zygotene**, the pairing of homologous chromosomes starts a process known as chromosomal synapsis, accompanied by the formation of a complex structure called synaptonemal complex. A pair of synapsed homologous chromosome forms a complex known as bivalent or tetrad.
- At **pachytene** stage, crossing over of non-sister chromatids of homologous chromosomes occurs at the recombination nodules. The chromosomes remain linked at the sites of crossing over.

Meiosis I

- **Diplotene** marks the dissolution of the synaptonemal complex and separation of the homologous chromosomes of the bivalents except at the sites of cross-over.
- The X-shaped structures formed during separation are known as chiasmata.
- **Diakinesis** is marked by the termination of chiasmata and assembly of the meiotic spindle to separate the homologous chromosomes.
- The nucleolus disappears and the nuclear envelope breaks down.

Phases of Meiosis I

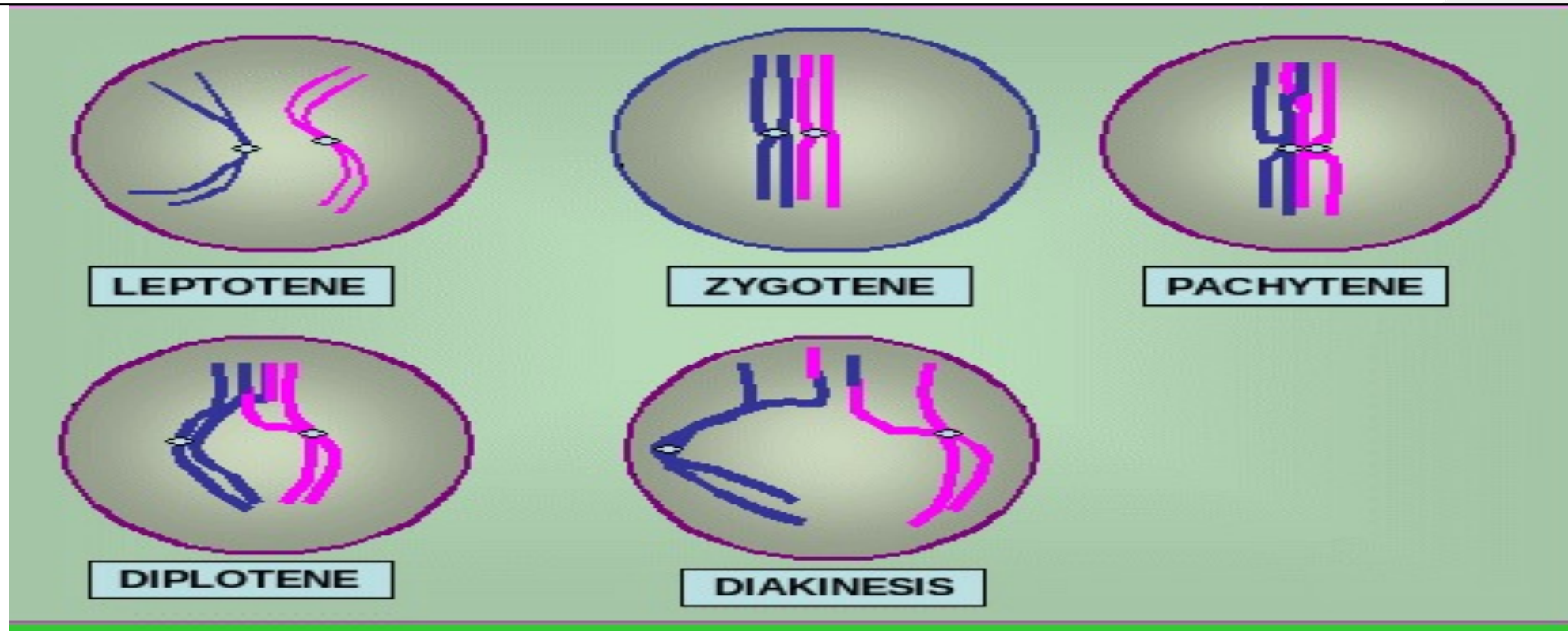


Fig.1.6 Prophase I

<https://qph.fs.quoracdn.net/main-qimg-3ac9012af04de9c4fa4fc047434941c8>

Meiosis I

- Meiosis 1 Metaphase 1
 - The bivalents align at the equatorial plate and microtubules from the opposite poles attach to the pairs of homologous chromosomes.
- Meiosis 1 Anaphase 1
 - The two chromosomes of each bivalent separate and move to the opposite ends of the cells. The sister chromatids are attached to each other.
- Meiosis 1 Telophase 1
 - The nuclear membrane reappears and is followed by cytokinesis. This gives rise to a dyad of cells.

PHASES OF MEIOSIS I

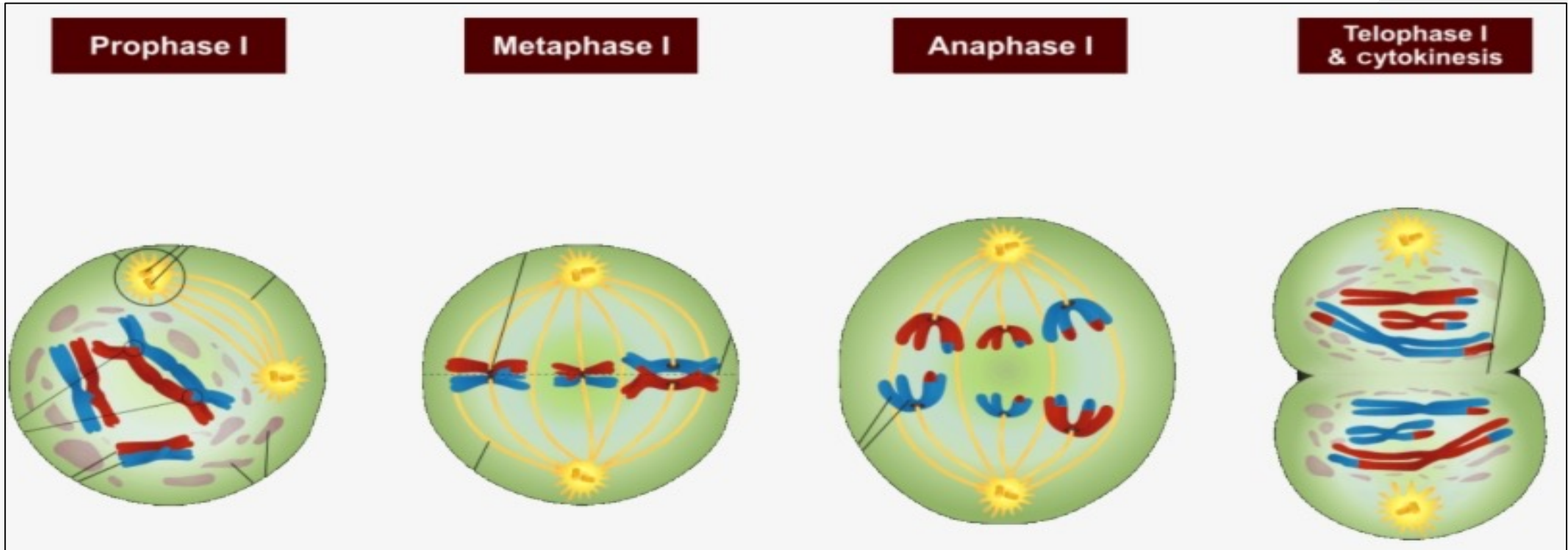


Fig.1.7: Phases of Meiosis I

https://www.seekpng.com/png/detail/235-2354733_cell-devision-meiosis-i-of-image-meiosis-1.png

Questions for Polling

Stages of Meiosis I

1. Leptotene
2. Zygotene
3. Pachytene
4. Diplotene
5. All of the above

MEIOSIS II

Meiosis II is an equational division

Four phases:

- Prophase II
- Metaphase II
- Anaphase II
- Telophase II

Meiosis II

- The four stages of meiosis II are as follows:-
- Prophase II – It immediately sets off after the cytokinesis when the daughter cells are formed.
- The chromosomes begin to condense accompanied by the dissolution of the nuclear membrane and the disappearance of the Golgi apparatus and ER complex.
- Metaphase II – The chromosomes are connected to the centriole poles at the kinetochores of sister chromatids through the microtubules.
- They also get aligned at the equator to form the metaphase plate.

MEIOSIS II

- Anaphase II – In this phase of meiosis II there is a simultaneous splitting of the centromere of each chromosome and the sister chromatids are pulled away towards the opposite poles.
- As the chromatids move towards the poles, the kinetochore is at the leading edge with the chromosomal arms trailing.
- Telophase II – The chromosomes dissolve again into an undifferentiated lump and a nuclear envelope develops around it.
- Followed by cytokinesis, telophase II marks the end of meiosis.
- Four haploid daughter cells are formed as a result.

SIGNIFICANCE OF MEIOSIS

- Reproduction in animals takes place through the fusion of gametes. If germ cells, which give rise to gametes, also maintains their ploidy during division like the somatic cells, the zygote will have an accumulation of chromosomes in its nucleus.
- Meiosis offers a very smart solution to this problem as it reduces the number of chromosomes in the gametes to half of their parent germ cells. Moreover, prophase I of meiosis allows recombination of homologous chromosomes.
- This recombination is essential for the variation to be introduced in the genetic makeup of the gametes as this variation only holds the key to evolution through sexual reproduction.

PHASES OF MEIOSIS II

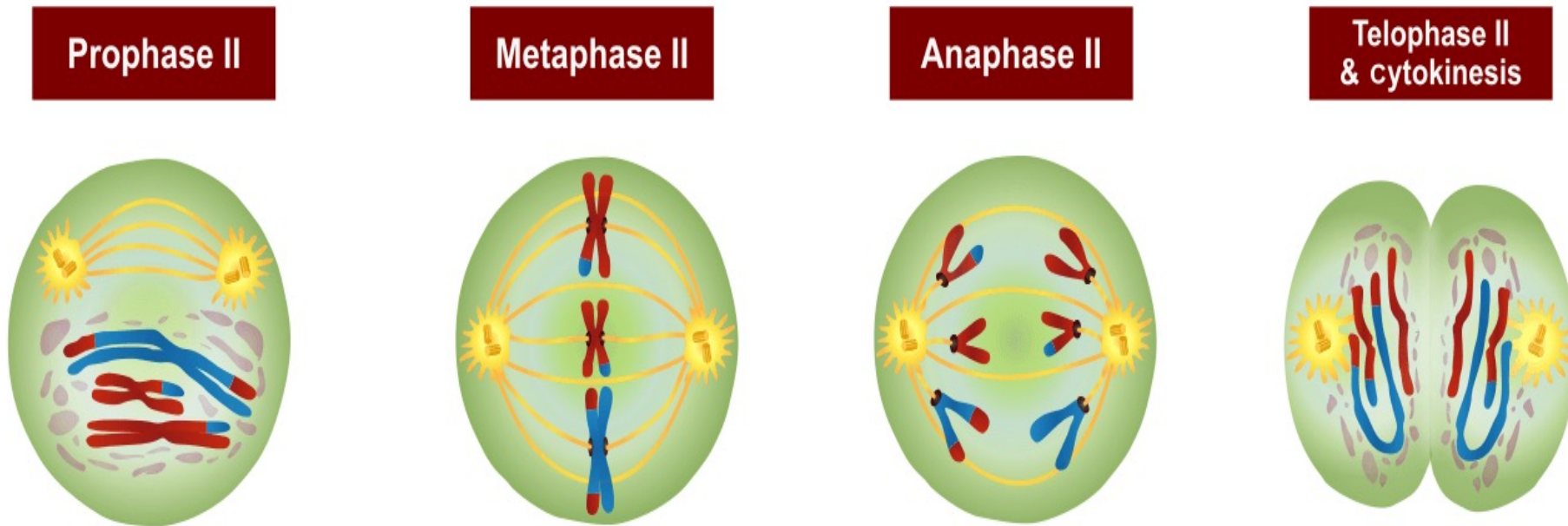


Fig. 1.8: Phases of Meiosis II

<https://163602-560839-raikfcquaxqncofqfm.stackpathdns.com/wp-content/uploads/2020/06/Phases-of-Meiosis-II.png>

MEIOSIS

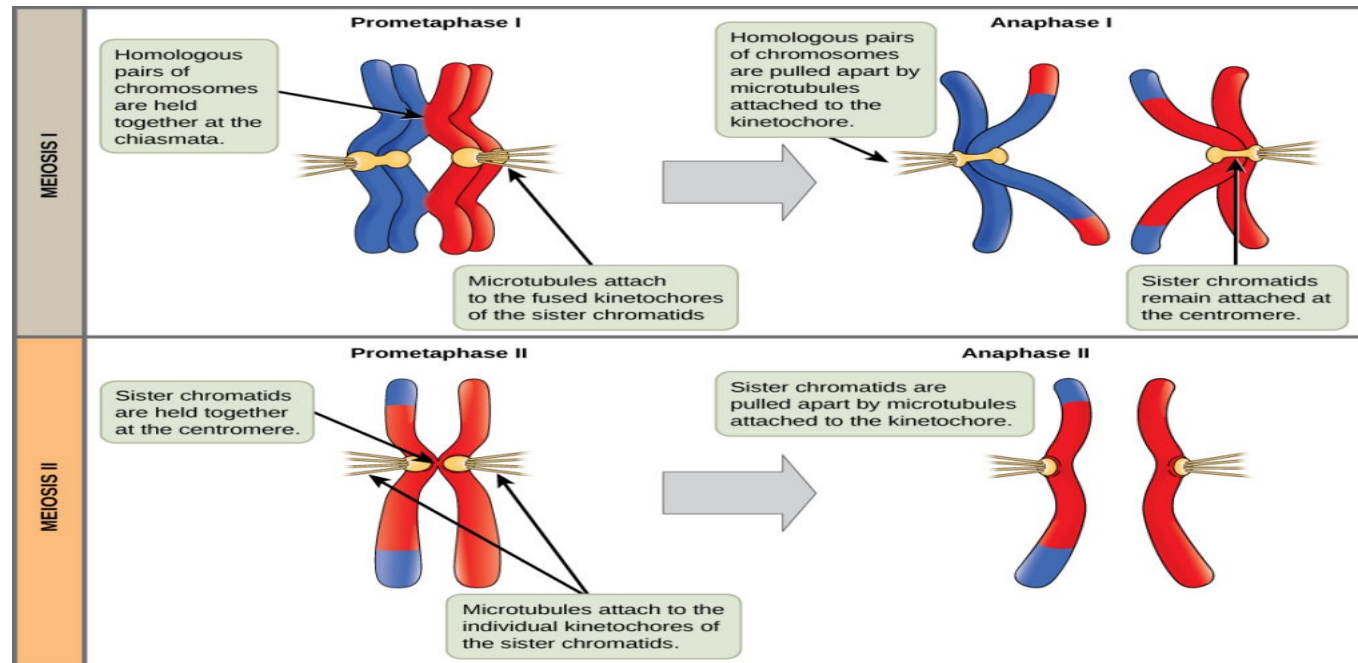


Fig 1.9 Meiosis

https://s3-us-west-2.amazonaws.com/courses-images/wp-content/uploads/sites/110/2016/05/03212035/Figure_11_01_041-1024x822.jpg

CONCLUSION

- Cell division is required for cell growth, repair, replacement and reproduction.:
- Meiosis
- Meiosis I
- Meiosis II
- Significance of Meiosis

HOME WORK

Q.1. Chiasma formation takes place during _____ phase.

- a) Zygotene
- b) Pachytene
- c) Diplotene
- d) None of the above.

Q3. Differentiate between mitosis and meiosis.

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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6. <http://www.digimat.in/nptel/courses/video/121106008/L13.html>
7. <https://youtu.be/c5hA0WCv1lg>



THANK YOU

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