Chapter = 05

Biology 9th - Detailed Question Answers

CELL CYCLE

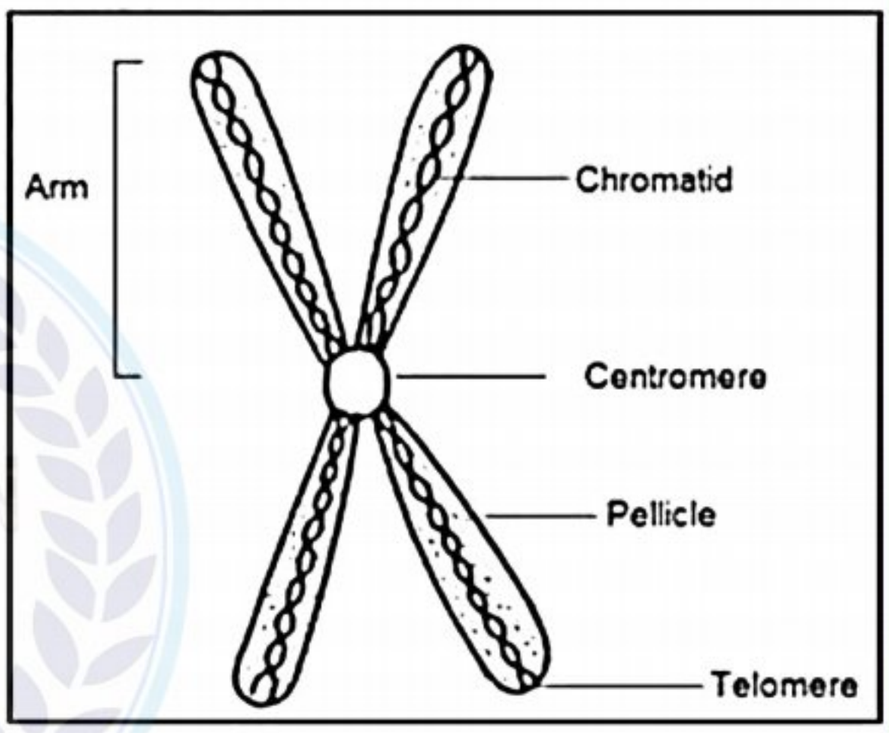
Q.1: How were chromosomes discovered?

Ans: The term Chromosomes is given by German embryologist Walter Fleming in 1882 when he was examining the rapidly dividing cells of salamander larvae after treating with Perkin's Aniline. He observed that chromosomes colour is much darker than the rest of organelles. The term chromosomes is misnomer because its means coloured body later it was found that chromosomes are colourless bodies.

Q.2: Define and briefly explain chromosomes.

Ans: **Chromosomes**: Chromosomes are thread like structure, appear at the time of cell division. They are found in specific numbers, made up of chromatin material in eukaryotic cell. They contain heredity units called Genes.

Chromosomes are made up of DNA and basic protein, Histones, appear during the cell division in the shape of rod. It has two part arms and centromere.



Q.3: Briefly describe the formation of chromosomes.

Ans: **Formation of Chromosomes**: Each chromosome in eukaryotes is composed of chromatin fiber, which is made of nucleosomes. Chromatin fibers are packaged by proteins into a condensed structure called chromatin. Chromatin allows the very long DNA molecules to fit into the cell nucleus. During cell division chromatin condenses further to form microscopically visible chromosomes. The structure of chromosomes varies through the cell cycle.

During cell cycle chromatin material replicate, divide and passed successfully to their daughter cells for survival of their progeny. Sometimes cell-division is also responsible for genetic diversity.

Q.4: Name the types of chromosomes.

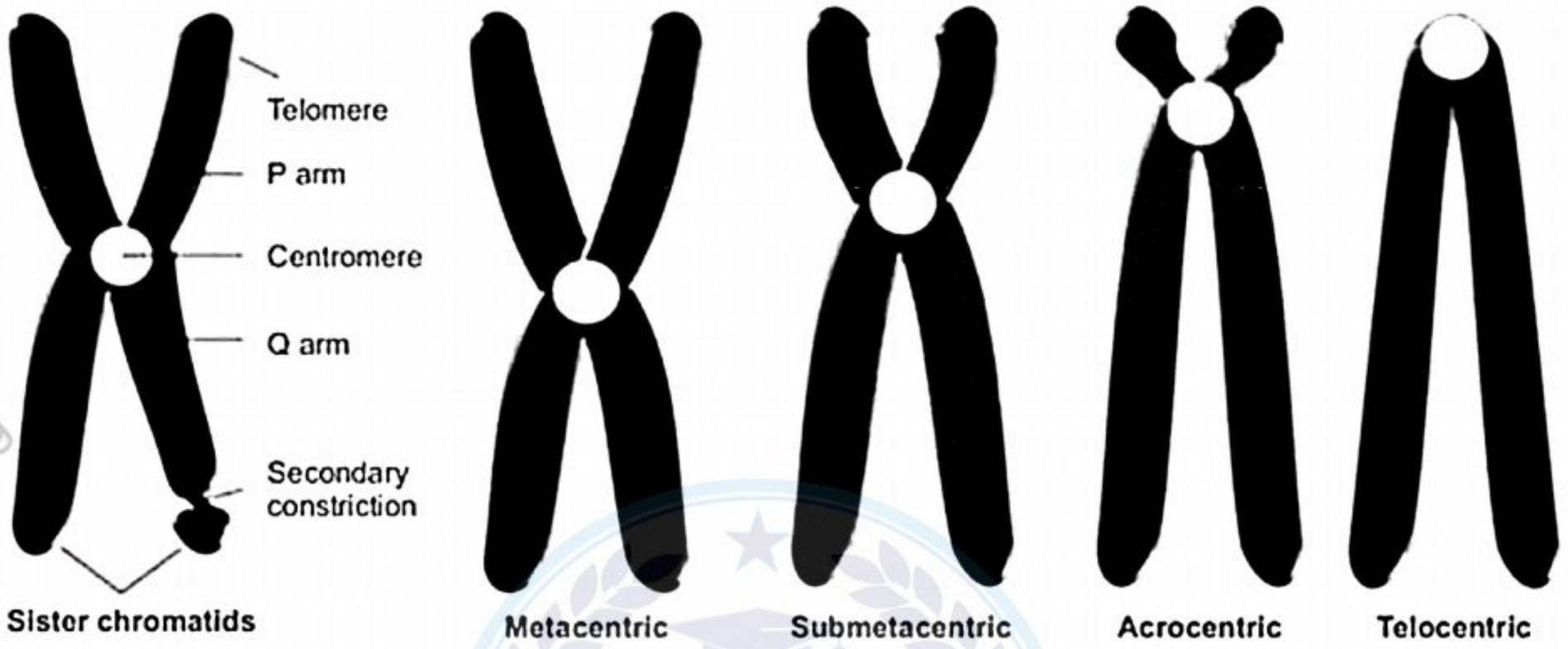
Ans: **Types of Chromosomes**: The chromosomes are of different types, depending upon position of centromere. These types are:

(i) **Metacentric**: Chromosomes with equal arms.

(ii) **Sub-meta centric**: Chromosomes with un equal arms.

(iii) **Acrocentric or sub-telocentric**: Rod like chromosomes with one arm very small and other very long. The centromere is sub-terminal.

(iv) **Telocentric**: Location of centromere at the end of chromosomes.



Q.5: What are chromatids?

Ans: **Chromatids**: In the beginning of cell-division each chromosome is consist of two genetically identical copies of thread attach with each other called chromatids or sister chromatids.

Q.6: Define cell cycle. How many phases a cell cycle has?

Ans: **Cell Cycle**: The sequence of changes which occurs between one cell division and the next is called Cell Cycle. The cell cycle undergoes a sequence of changes, which involve period of growth, replication of DNA following by cell division. This sequence of changes is called cell cycle.

It has two phases:

(i) Interphase, which is the period of non-division.

(ii) M-phase, which is a period of cell division.

Q.7: Explain interphase and its sub-phases.

Ans: **Interphase**: The period of cell cycle between two consecutive divisions is called Interphase. It is a period of growth and synthesis of DNA. During this period of cell prepares itself for the M-phase.

Sub-phases of Interphase: The Interphase is divided further into three sub-phases:

(1) G1-Phase (2) S-phase (3) G2-phase.

(i) **G1 (Gap one) phase:** It is the period of extensive metabolic activity, in which cell grows in size, specific enzymes are synthesized and DNA base units are accumulated for the DNA synthesis. At a point in G1, the cell may enter into a phase called G_o (G-knot) were cell cycle stops. It remains for days, weeks or in some cases even for the life time of the organism.

(ii) **S(Synthesis) phase:** During this phase, replication of DNA occurs. As a result of its chromatin material is duplicated.

(iii) **G2(Gap two) phase:(Pre-Mitotic Phase):** In this phase, cell grows is size, cell organelles are replicate in numbers as well as enzyme require for cell-division also synthesize during this phase.

Q.8: Define mitosis.

Ans: **Mitosis**: In this type of cell division a parent cell divides into two daughter cells in a way that the number of chromosomes in the daughter cells remains the same as in the parent cell.

Q.9: Describe the phases of mitosis. Draw a neat and labeled diagram.

Ans: **Phases of Mitosis**: Although mitosis is a continuous process, but for the study point of view are can divide it into two phases:

(a) Karyokinesis - nuclear division

(b) Cytokinesis - cytoplasmic division

(a) **Karyokinesis**: The Karyokinesis can be divided further for convenience into four phases which are:

(i) Prophase (ii) Metaphase

(iii) Anaphase (iv) Telophase

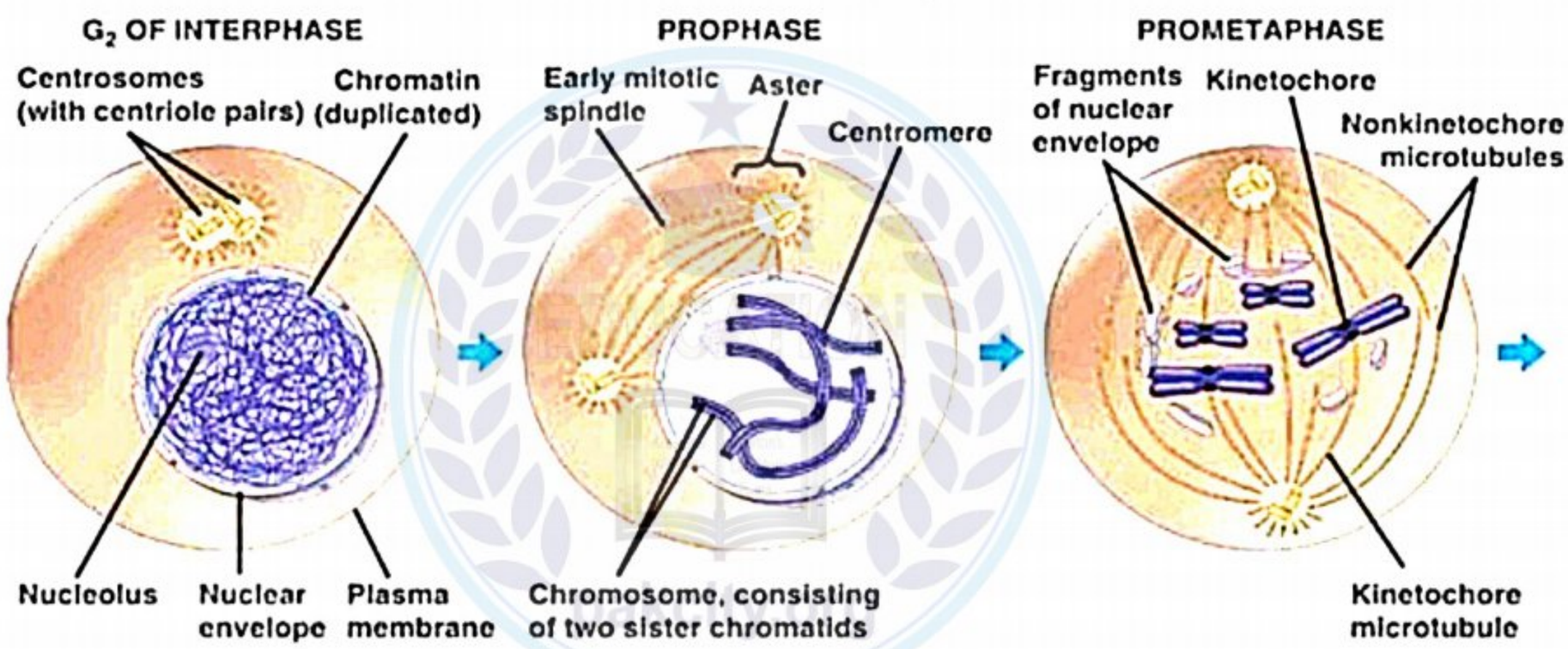
(i) **Prophase**: During early prophase chromatin material condenses and become visible as thick coiled, threadlike structures called chromosomes. Each chromosome at this stage is already double, consists of two chromatids. The chromatids are attached to each other at centromere. The nuclear membrane gradually disappears and at the same time Centrosome divides to form two centrioles, each moves

towards the opposite pole of the animal cell and forms the spindle fibers. The centrioles are absent in plant cells.

(ii) **Metaphase**: During this phase each chromosomes arranges itself on the equator of the spindle. Each chromosome is attached to separate spindle fibre by its centromere.

(iii) **Anaphase**: In this phase the spindle fibre contract, centromere of a chromosome divides and the chromatides of each chromosome separates from each other and move towards the other poles. In this way one set of the chromatids (each chromatid is now an independent chromosome) move towards one pole while the other set towards the other pole.

(iv) **Telophase**: This is a stage when the chromatids (now called chromosomes) reach at the respective poles and their movement ceases. Each pole receives the same number of chromosomes as were present in the parent cell. The nuclear membrane is reformed around each set of chromosomes. In this way two daughter nuclei formed in each cell.



(b) **Cytokinesis**: Soon the cytoplasm of the cell also divides and two daughter cells are formed. In animal cell cytokinesis takes, place by developing a constriction. This constriction become deep to divide cytoplasm in two equal halves and two daughter cells are formed. In plant cells it occurs by developing cell plate. In this way the daughter cells become the exact copies of their parent cell.

Q.10: What is the significance of mitosis?

Ans: **Significance of Mitosis**: Mitosis plays an important role in the life of an organism.

(i) It is responsible for development and growth organisms by increasing exact copies of cells.

(ii) With few exceptions all kinds of asexual reproduction and vegetative propagation take place by mitosis.

(iii) The production of new somatic cells, such as blood cells depends on mitosis.

(iv) The healing of wounds, repair of wear and tear within organism is also dependent upon the mitotic division.

Q.11: Why mitosis is necessary for growth?

Ans: Mitosis is a way of making more cells that are genetically the same as the parent cell. It plays an important part in the development of embryos, and it is important for the growth and development of our bodies as well. Mitosis produces new cells, and replaces cells that are old; lost or damaged.

Q.12: What do you know about cell death? Define apoptosis and necrosis.

Ans: **Cell Death**: Cell in an organism depends upon various extra cellular signals for its regulated and controlled activities. It means all the activities even the death of cells is programmed. Programmed cell death helps in proper control of multicellular development, which may lead to deletion of entire structure, e.g. the tail of developing human embryo, or so e part an organ which is more required like tissue between developing digits.

Ways of Cell Death: There are two ways of cell death in multicellular organisms.

Apoptosis or Self-Destruction (Autophagy): "Programmed change which lead to sequence of physiological changes in cell by which cells commit suicide collectively called Apoptosis".

Necrosis: This type of cell death is caused by external factors i.e. infection, toxin an tumor i.e. accidental cell death.

Q.13: Define meiosis.

Ans: **Meiosis**: Meiosis is a type of cell division in which single cell divides into four daughter cells and number of chromosomes becomes half in each daughter cell.

Q.14: Briefly describe the phases of meiosis.

Ans: **Phases of Meiosis**: In animal meiosis takes place in germ cell to produce gametes i.e. sperms and eggs whereas in plants it takes place in spore mother cells (S.M.C) to produce spores.

Meiosis is a series to two divisions, MEIOSIS I and MEIOSIS II with result in the formation of four haploid cells.

Meiosis I (First Meiotic Division): First meiotic division is the reduction division during which the chromosomes number is reduced to half. Meiosis I consists of Prophase I, Metaphase I, Anaphase I and Telophase I.

Prophase I: It consists of the longest phase of meiosis. It can be subdivided into following sub stage:

(i) Leptotene (ii) Zygotene (iii) Pachytene
(iv) Diplotene (v) Diakinesis

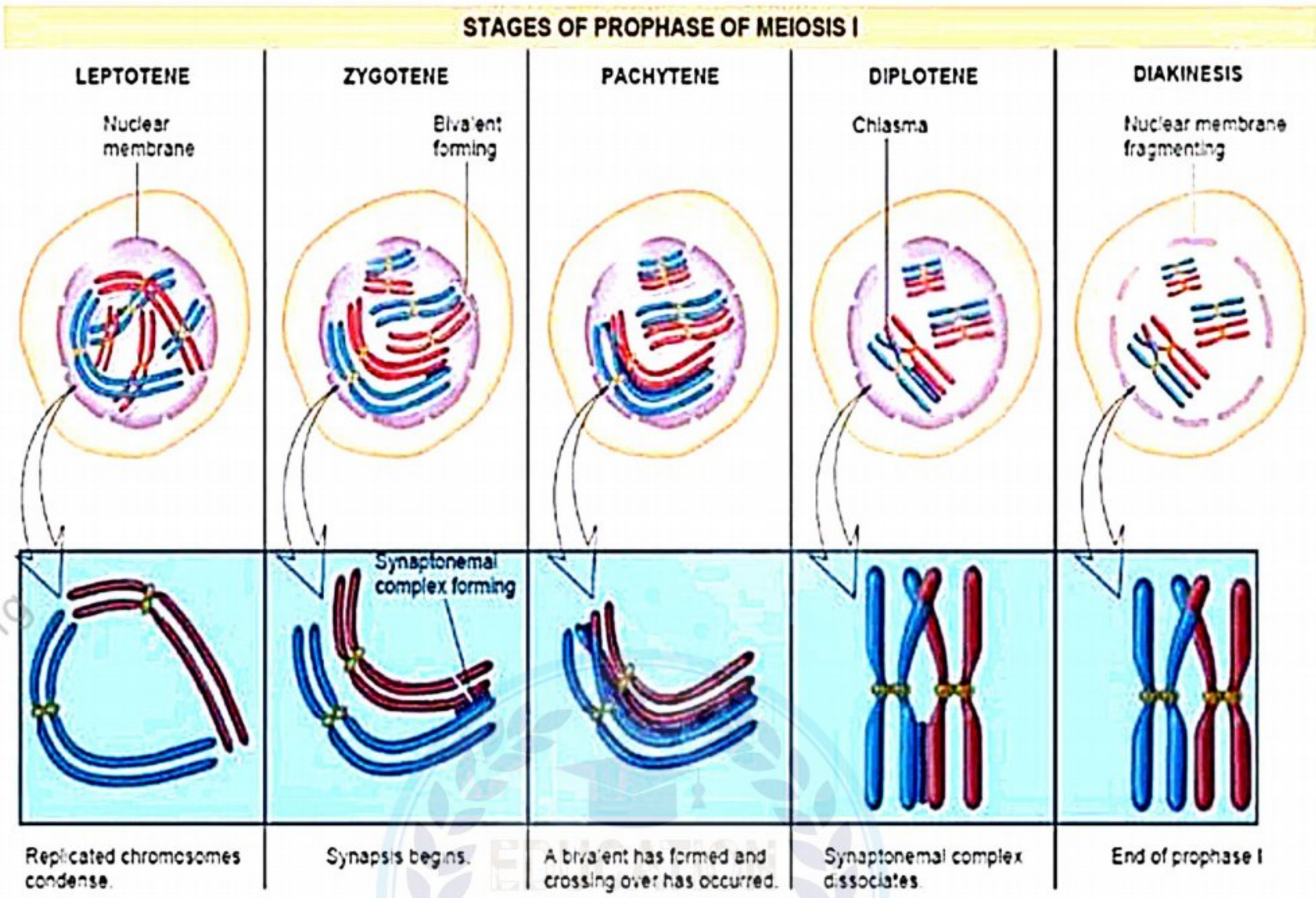
(i) **Leptotene**: During this sub stage, the chromatin network breaks into specific number of long thin beaded thread called leptotene. Each thread has two morphologically similar leptotene in each cell called homologous structure.

(ii) **Zygotene:** During this sub stage, the homologous (similar structure) chromosomes, which comes from the mother (by ovum) and father (by sperm) are attached towards each other and their lengthwise pairing takes place. The pairing of homologous chromosomes is known as synapsis, while the paired homologous chromosomes are known as bivalent.

(iii) **Pachytene**: The synaptic forces of attraction between each bivalent decrease and the chromosomes uncoil and separate. The separation is however incomplete and paired chromosomes are in contact with each other at one or more points, called Chiasmata. Each homologous chromosome split longitudinally except in the centromere region. No each bivalent is composed of four chromatids and therefore in known as bivalent tetrad.

(iv) **Diplotene**: The homologous chromosomes exchange their parts of chromatid at Chiasmata. This exchange of segments of chromatids at chiasmata between the homologous chromosomes is called Crossing Over.

(v) **Diakinesis:** During this sub stage, nucleoli and nuclear membrane are disappeared, whereas Mitotic Apparatus (spindle) is completed. Chiasmata moves from the centromere towards the ends of the chromosomes like a zipper. This type of movement of chiasmata is known as Terminalization. At the end of diakinesis, chromatids still remain compacted at their ends.

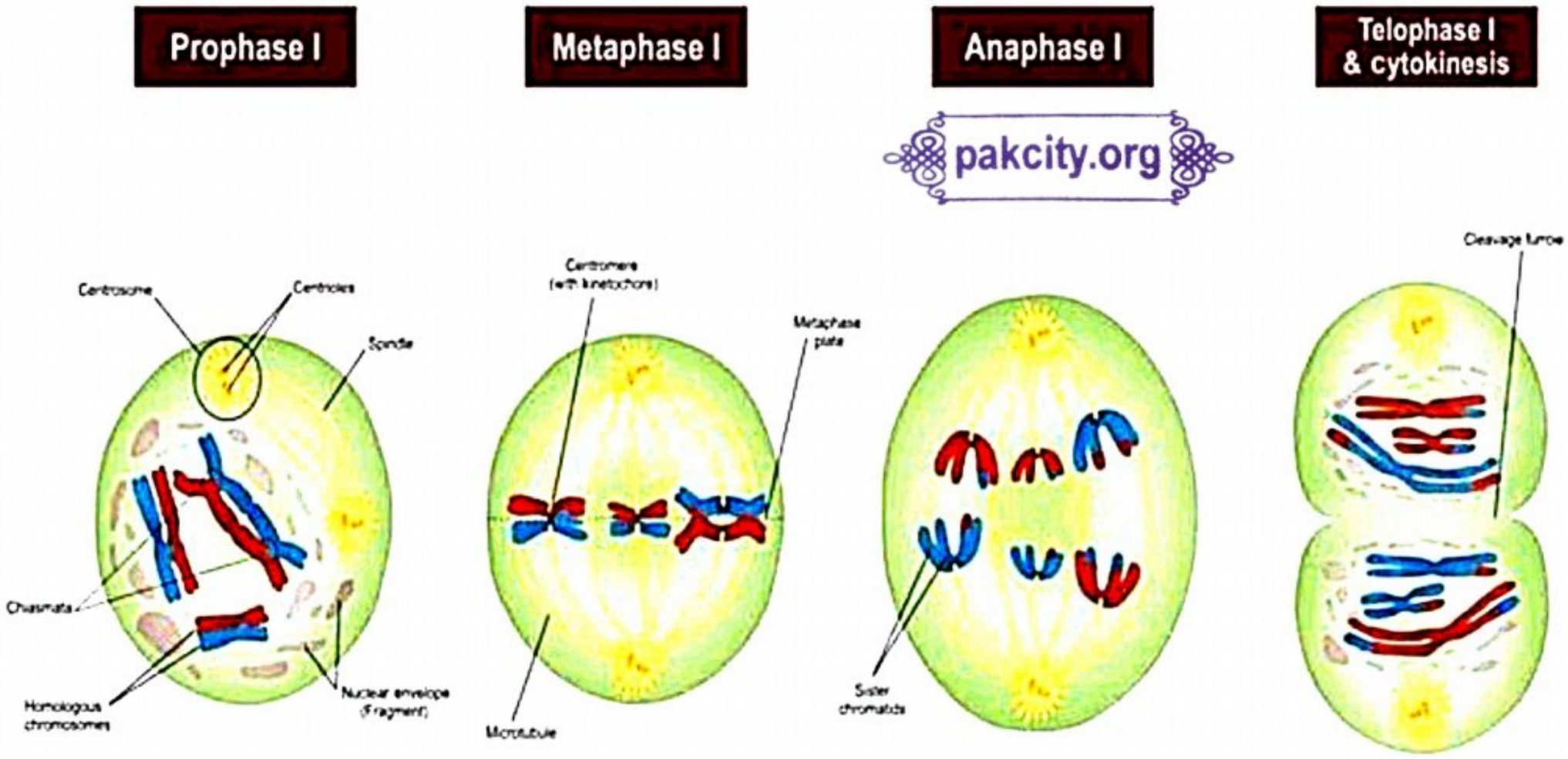


Metaphase I: In this phase, the bivalent line up at the equatorial plane. The centromere of each chromosome attached with same fibres of spindle.

Anaphase I: At this stage one chromosome from each member homologous pair (bivalent) begins to separate and move towards its respective pole by the contraction of spindle fibers. The actual reduction occurs at this stage because half the number of chromosomes moves to each pole. Moreover as a result of crossing over the two chromatids of a chromosome do not resemble with each other in the genetic terms.

Telophase I: The nuclear membrane form around the chromosomes at each pole and chromosomes become uncoil. The nucleolus reappears and thus two daughter nuclei formed.

Cytokinesis: Telophase may or may not be accompanied by cytokinesis and daughter cells formation.



Interphase: Following telophase I (if. this stage occurs), there is a short period called Interphase before meiosis II. It is similar to Interphase between mitotic divisions except that DNA replication does not occur. Replication of DNA is unnecessary because each chromosome already has two chromatids.

Second Meiotic Division (Meiosis II): The second meiotic division is actually the mitotic division which divides each haploid cell formed during meiosis I into two daughter haploid cells. The second meiotic division includes:

(i) Prophase II (ii) Metaphase II

(iii) Anaphase II (iv) Telophase II

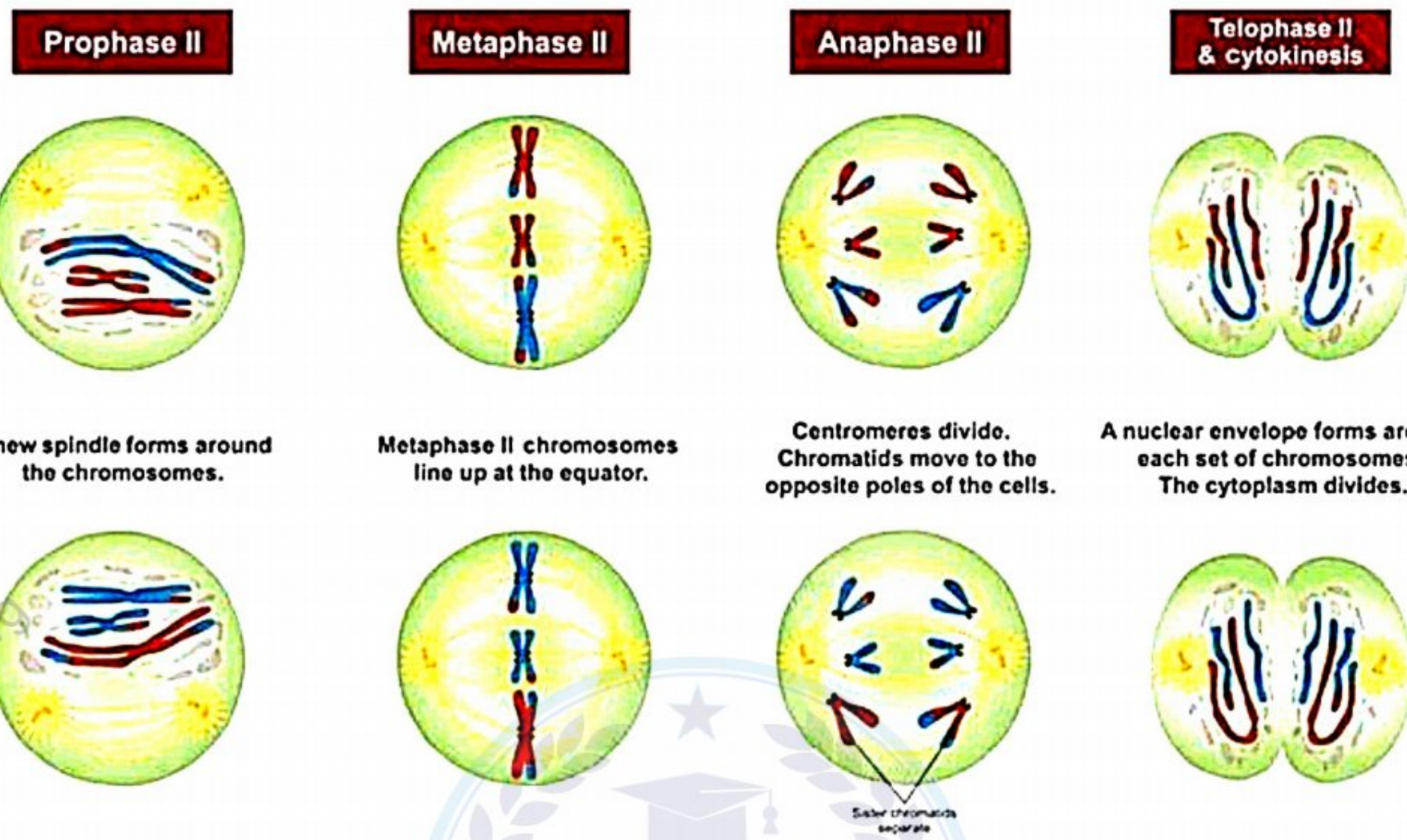
(i) **Prophase II**: The spindle fibres are formed. The nuclear membrane and the disappear.

(ii) **Metaphase II**: The chromosomes are attached to half spindle fibers by their centromere and get arranged at equatorial plane. Each chromosome attach with separate fiber of spindle.

(iii) **Anaphase II**: The spindle fibers attached to the centromeres shorten and the chromatids of chromosomes are pulled away one another. This movement continues until one complete set of chromosomes is positioned at each pole of the cell.

(iv) **Telophase II:** The spindle fibers disappear completely and chromosomes being to uncoil. They become longer and indistinct and form group at each pole. Around each group nuclear envelope is formed.

After the Karyokinesis in each haploid meiotic cell the cytokinesis Le. division of cytoplasm occurs and thus four haploid cells are formed.



Q.15: What happens in the absence of meiosis?

Ans: In the absence of meiosis number of chromosomes would have been doubled giving rise to abnormal growth, changes in species characteristics and or may prove fatal.

Q.16: What is the significance of meiosis?

Ans: **Significance of Meiosis:**

(i) **Constant number of Chromosomes:** Meiosis maintains chromosome number constant from generation to generation. It is due to the fact that meiosis reduces the diploid number of chromosomes to half i.e. haploid in the gametes.

During fertilization the diploid number of the chromosomes is restored.

(ii) **Responsible for genetic variation among species:** By crossing over, the meiosis provides an opportunity for the exchange of the genes between homologous chromosomes and thus cause the genetic variations among the species. The variations are the raw material of the evolutionary process.

Q.17: Explain phenomenon of non-disjunction.

Ans: **Non-disjunction**: In normal course of meiosis, the two chromosomes of each homologous pair separates and enter into two gametes, but sometimes a pair of homologous chromosomes fails to separate from one another, during meiosis I. This phenomenon is called Non-disjunction.

Non-disjunction produces gametes with abnormal number of chromosome i.e. either with less or extra chromosome. If such abnormal gametes fuse with normal gametes, the resulting zygote will also have abnormal number of chromosome.

Q.18: What is the difference between mitosis and meiosis?

Ans:

	Differences	Mitosis	Meiosis
1.	Type of Reproduction	Asexual	Sexual
2.	Genetically	Daughter cells are genetically Identical	Daughter cells are genetically different
3.	Crossing Over	No recombination/crossing over occurs in prophase	Involves recombination/crossing over of chromosomes in prophase I
4.	Number of divisions	It involves one cell division	It Involves two successive cell divisions.
5.	Pairing of Homologs	No	Yes
6.	Mother Cells	Can be either haploid or diploid	Always diploid
7.	Number of Daughter Cells produced	2 diploid cells	4 haploid cells
8.	Chromosome Number	Remains the same	Reduced by half
9.	Chromosomes Pairing	Does Not Occur	Takes place during zygotene of prophase I and continue upto metaphase I
10.	Creates	Makes everything other than sex cells	Sex cells only: female egg cells or male sperm cells
11.	Takes Place in	Somatic Cells	Germ Cells
12.	Chiasmata	Absent	Observed during prophase I and metaphase I
13.	Spindle Fibres	Disappear completely in telophase	Do not disappear completely in telophase I
14.	Nucleoli	Reappear at telophase	Do not reappear at telophase I

15.	Centromere Split	The centromeres split during anaphase	The centromeres do not separate during anaphase I, but during anaphase II
16.	Prophase	Simple Duration of prophase is short, usually of few hours	Complicated, Prophase is comparatively longer and may take days
17.	Synapsis	No Synapsis	Synapsis of homologous chromosomes takes place during prophase
18.	Exchange of Segments	Two chromatids of a chromosome do not exchange segments during prophase	Chromatids of two homologous chromosome exchange segments during crossing over
19.	Function	Cellular reproduction and general growth and repair of the body. Takes part in healing and repair	Genetic diversity through sexual reproduction. Takes part in the formation of gametes and maintenance of chromosome number
20.	Where it occurs?	Occurs in all organisms, except viruses	Only occurs in animals, plants, and fungi

Q.19: Differentiate between the following:

(i) Prophase and Prophase I

(ii) Prophase and Telophase

(iii) Apoptosis and Necrosis

Ans: **Difference between Prophase and Prophase I**

	Prophase	Prophase I
1.	Pair formation in between homologous chromosomes	It is a long phase and is divided into the sub phases.
2.	Does not occur as there is no attraction between them.	Pair formation (synapsis) due to attraction occurs in between homologous chromosomes
3.	Chiasma is not formed	Chiasma is formed
4.	Crossing over does not occur	Crossing over occurs
5.	Part exchange does not occur in the chromosome. So gene arranges not remains unchanged.	Part exchange occurs, which changes the gene arrangement of the chromosomes

Difference between Prophase and Telophase

	Prophase	Telophase
1.	Prophase is the first stage in mitosis	Telophase is the final stage in meiosis and mitosis
2.	In prophase the chromatin condenses to form the chromosomes.	In telophase the daughter chromosomes move towards the opposite ends of the spindle fibers.
3.	In prophase the nuclear content is not initiated to be distributed.	In telophase the nuclear content get equally distributed to become the part of daughter cells

Difference between Prophase and Necrosis

	Prophase	Necrosis
1.	Apoptosis, or programmed cell death, is a form of cell death that is generally triggered by normal, healthy processes in the body.	Necrosis is the premature death of cells and living tissue. Though necrosis is being researched as a possible form of programmed cell death, it is considered an "unprogrammed" cell death process at this time.
2.	It is usually beneficial. Only abnormal when cellular processes that keep the body in balance cause too many cell deaths or too few	Its effect is always detrimental
3.	Nucleus gets fragmented	Nucleus gets disorganized
4.	Chromatin condensation is a hallmark of apoptosis	No chromatin condensation occurs

Q.20: Why meiosis-I is called reduction division?

Ans: Meiosis is called reduction division because it reduces the number of chromosomes from diploid to haploid i.e. it gets reduced from 2N to IN (46 to 23) so as to maintain the species specific number 46 chromosomes(23 pairs) from generation to generation.

Q.21: How number of chromosomes remains constant from generation to generation?

Ans: There are 23 pairs of chromosome which are constant. The chromosome number is kept constant from generation to generation because of process of mitosis and meiosis.

While mitosis is equal division which ensures the chromosome number remains same in somatic cells, meiosis is reduction division which takes place in reproductive cells.

The chromosome number is reduced to half in the gamete cells so that fertilization restores it back to the original number.

Q.22: Why Interphase is called as phase of high metabolic activities?

Ans: Interphase is the portion of the cell cycle. It includes the G1, S and G2 phases. During interphase, the cell grows (G1), replicates its DNA (S) and prepares for mitosis (G2). Interphase is the phase of the cell cycle in which atypical cell spends most of its life. During interphase, the cell copies its DNA in preparation for mitosis. Interphase is the 'daily living' or metabolic phase of the cell, in which the cell obtains nutrients and metabolizes them, grows, reads DNA, and conducts other "normal" cell functions.

Q.23: Why interphase between meiosis-I and meiosis-II is short?

Ans: Interphase is a stage associated with replication of DNA, and growth. Once meiosis starts, the purpose is to produce a haploid gamete. So there is no further need of replication or growth. Hence between meiosis I and meiosis II, interphase is short.

Chapter = 05

Biology 9th - Short Question Answers

→ CELL CYCLE

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