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Where Minds Pollinate

Class 9
Biology 

Chapter 5

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Cell Cycle

Definition :-

Cell cycle is sequence of events which involves growth of newly formed cells, replicates its genome and divide into two daughter cells ultimately.

Interphase :-

Interphase is the period in cell cycle b/w 2 consecutive divisions. It is divide into :-

G₁ phase :- (Growth Phase)

1. It starts from production of new cell.
2. Cell grows in size, increases no. of organelles, forms needed proteins n other sub.
3. In this phase cell prepares itself for next phase of cell cycle (S-phase).
4. It form enzymes nd nucleotides of DNA required for replication process.

G₀ phase :- (Coma)

1. During G₁ Cell may exit cell cycle n enter G₀ phase. In G₀ cell stops to divide.
2. Neuron cells, once mature nvs divide again. They remain in G₀ phase permanently.
3. Cells of liver, kidney etc. Enter G₀ phase temporarily, when needed they re-enter cell cycle and start to divide again.
4. Many epithelial cells nvs enter G₀ phase. They divide continuously.

S phase :- (Synthesis)

1. It is synthesis phase of DNA.
2. The cell replicates its entire genetic material form its 2 copies.
3. That is why each chromosome has two chromatids, one for each daughter cell.
4. These chromatids are attached w

G₂ phase :-

1. During this phase cell prepares 4 Mitotic phase.
2. Cell forms proteins especially those that are required for formation of spindle fibers.
3. Cell accumulates (store) energy to complete division process.
4. More mitochondria are formed.

• Formation of spindle apparatus :-

(intro)

(detail)

Cytoskeleton of eukaryotic cell form spindle Apparatus durin cell division. Major component of CS are microtubules (tubulin). SA separate chromatid or chromosome during cell division n move them to opposite pole. In this way hereditary material of parent cell is equally distributed into daughter cell.

A pair of centriole is located near nucleus of animal cell. They duplicate and another pair is formed. Both pairs migrate to opposite pole. They also give rise to spindle fibers. Spindle apparatus is formed around the nucleus but as soon as nuclear envelope disappears they penetrate into the region of nucleus. Later they attach on centromere of chromosome n pull them to their pole.

→ There is no centrioles in plant cell, spindle apparatus of plant cell is formed without centrioles.

Caryokinesis in Animal cell

(Intro plant cell.)

1. Cell membrane in animal cell begin to invaginate in equator region.
2. As a result cleavage furrow is formed which continues to grow inward.
3. Cell membrane in furrow join up and separate the two daughter cell.

1. In plant cell, spindle fibers in equator region form a structure called phragmoplast.
2. Golgi apparatus form vesicles which appear in center of phragmoplast initially and grow at equatorial plane.

Mitosis

• Definition:-

The cell division in which parent cell produces two daughter cell with same no. of chromosomes as the parent cell. Continuous and very fast process take less than an hour. but to study easily it is divided into:-

Karyokinesis

Cytokinesis

- | | |
|---|---|
| <ul style="list-style-type: none"> • Division of nucleus. • Happens first during cell division. • form two daughter nuclei (Result) • Include stages :- | <ul style="list-style-type: none"> • Division of cytoplasm. • Happens after karyokinesis. • form two separate daughter cells. • Involves splitting the cell into two parts. |
|---|---|

* Prophase:-

(During interphase hereditary material is found in form of very thin threads called chromatin. If a cell is going to divide, all of chromatin fibers duplicate during S-phase in IP) Prophase is longest phase of cell division. At start, chromatin fibers coil up and condense into chromosomes. Due to duplication each chromosome has two chromatids. These chromatids of chromosomes attach to each other at centromere. Nucleolus disappears as its DNA is packed into chromosome.

Metaphase

Anaphase

Telophase (Opposite of prophase)

- | | | |
|--|---|--|
| <ol style="list-style-type: none"> 1- Chromosomes are aligned at equator of spindle. 2- Two spindle fibers, one from each pole, are attached at centromere of chromosomes. | <ol style="list-style-type: none"> 1- Spindle fibers pull centromere which splits and chromatids are separated and pulled until they reach their respective poles. 2- Individual chromatids are pulled until they reach their respective poles. | <ol style="list-style-type: none"> 1- Chromatids reach at their pole. 2- They uncoil and lengthen to form chromatin fibers again. 3- SA disappear. 4- Nuclear membrane formed around chromatin at each pole. 5- Nucleoli reappear in both nuclei. |
|--|---|--|

Significance of Mitosis.

The main function of mitosis is to maintain number of chromosomes n genetic material in dividing cell.

⇒ Following are the significance of mitosis:-

Genetic Stability:-

1. Mitosis produce two daughter cell with same number of chromosomes.
2. At the start of cell division, DNA of parental chromosome replicates to form 2 exact copies. Thus daughter cell will have same genetic info.

Cell replacement n wound healing:-

1. Replacement of worn out cell involves mitosis.
2. The epithelial cells of skin, digestive tract, respiratory tract die off regularly.
3. They are replaced by identical cells.
4. Damage, repair n wound healing depend on the process of mitosis.

Development n Growth:-

1. Life of multicellular organism start from a single cell, the zygote.
2. The continuous process of cell division leads to development of an adult.
3. The organism also grow in size by $\uparrow$ cell no.
4. Development of multicellular organism depends on mitosis.

Regeneration:-

1. Some animals have ability to form whole part of body if it is removed. This is called regeneration.
2. e.g:- sea can regenerate arm, earthworm can regenerate head, salamander $\rightarrow$ limb
3. Production of new cells to form missing parts involves mitosis.

Asexual reproduction:-

1. Mitosis is basis of asexual reproduction. This reproduction involves one parent. The asexually produced offspring are genetically identical to parent.
2. Vegetative propagation is very common in plants. It involves formation of new plant from stem, leaf or root of parent plant. Potato, garlic, onion, grasses etc reproduce asexually.
3. Many animal like sponges, planaria and hydra undergo asexual reproduction.

Meiosis

Definition:-

- It is a type of cell division which give rise to 4 daughter cells each having half no. of chromosomes of parent cells.
- It only take place in cells which are involved in sexual reproduction.
- The parent cells are diploid which produces haploid gametes by process of meiosis.

Diploid (2n)

Haploid (n)

- | | |
|---|--|
| <ul style="list-style-type: none"> • Contain 2 set of chromosomes • Chromosomes are present in homologous pair. • Parents cells are usually diploid. • Human diploid no. = 46 chromosomes | <ul style="list-style-type: none"> • Contain one set of chromosomes. Half no. of a cell • Contain one member of each homologous pair. • Gametes (sex cells) are haploid. • Gametes haploid no. = 23. (Human) chromosomes |
|---|--|

Meiosis is a continuous process but convenience is divided into : Interphase I, meiosis I, Interphase II, meiosis II

Interphase I

By the start of cell division process

- 1) Cell form a copy of its genome by replication process.
- 2) That is why each chromosome appears with 2 chromatids during division process.

Meiosis I - Reduction

- 1) It is reduction division in which daughter cell reduces no. of chromosomes into half.
- 2) Firstly, karyokinesis produces two haploid nuclei which is followed by cytokinesis.

* Karyokinesis in Meiosis I :-

It is further divided into :

Prophase I, Metaphase I, Anaphase I, Telophase I.

Prophase I

- 1) Longest phase of meiosis.
- 2) Chromosomes appear as thicker fibres due to coiling of chromatin.
- 3) **Synapsis** :- Homologous chromosomes line up point to point against each other and form pairs. Their centromere is at same position. This pairing process is called synapsis.
- 4) **Bivalent** :- Each pair is called bivalent.
- 5) **Chiasmata** :- Non-sister chromatid of homologous chromosomes join each other at a point along their length. These points are called chiasmata. Each chiasma is a site

for exchanging genetic material b/w chromatids.

6) **Crossing over** :- The exchange of segments of non-sister chromatid in prophase I.

7) **End** :- In the end of prophase I, chromosomes fully condensed and pairs chromosomes repel each other. However they are still attached at chiasmata.

Nucleoli and nuclear envelope disappear. Spindle apparatus is formed.

Homologous chromosomes

- Similar in size, shape and gene position.
- Form a pair (one from mother, one from father)
- Pairs during meiosis I.

Heterologous chromosomes

- Diff in size, shape, and gene position
- Do not form a matching pair.
- Do not pair during meiosis.

Question :- Which phase make mitosis different from Meiosis?

Mitosis resembles Meiosis II, while the major differences b/w mitosis and meiosis occur in meiosis I (especially prophase I and anaphase I).

Anaphase 1

- 1) Spindle fibers pull homologous chromosomes from opposite end.
- 2) Separated chromosomes of each pair move to opposite pole.
- 3) Each pole receives a haploid set of chromosomes.

Telophase 1

- 1) Once at their pole, chromosomes uncoil to form chromatin.
- 2) A nuclear envelope (membrane) is formed at each pole around haploid set of chromatin.

Metaphase 1

- 1) Bivalents are arranged at the equatorial plate.
- 2) Spindle fibers attached to centromere of chromosome.
- 3) One member of a homologous pair receives spindle fibers from 1 pole and other member receives from opposite pole.

Cytokinesis

- 1) Cytokinesis occurs by cleavage in Animal cells and by forming cell wall in plant cells.
- 2) Although each daughter cell is haploid with half no. of chromosomes, their chromosomes are composed of two chromatids.
- 3) These chromatids are not genetically identical due to crossing over. They must be separated in meiosis II.

Interphase II

This phase varies in length but no further DNA replication occurs during this phase.

Prophase II

- 1) Chromatin again coil up so chromosomes appear as thick fibres
- 2) Spindle apparatus is organized
- 3) Nucleoli disappear
- 4) Nuclear envelope disintegrates

Anaphase II

- 1) Centromere divide
- 2) Spindle fibres pull chromatids to opposite poles

Meiosis II

It is similar to mitosis and further divided into:

Prophase II, Metaphase II, Anaphase II, Telophase II.

Metaphase II

- 1) Chromosomes line up separately around the equator of spindle.
- 2) Spindle fibres are attached to centromere of chromosomes.
- 3) Like mitosis here each chromosome is attached by fibres from both poles

Telophase II

- 1) Chromatid reach at their pole and uncoil.
- 2) Spindle apparatus disappears.
- 3) Nuclear envelope is formed around chromatin at each pole.

Cytokinesis :-

- 6) Cleavage furrow form cell membrane in animal cell and cell wall formation in plant cells give rise to 4 daughter cells at the end of meiosis.
- All cells formed by meiosis are haploid as they have half no. of parental chromosomes.
- Also they have variation in genetic makeup bcz of crossing over b/w homologous chromosomes during meiosis I.

Significance of Meiosis

Genetic Variations

- 1- Variations are the differences among the members of same species.
- 2- They are necessary for survival of species in changing environment.
- 3- It is bcz of meiosis that new gene combination appears in gametes and then in zygotes.
- 4- Crossing over and Chromosomal combination is basis of variation. (Provide).

Maintenance of chromosomes in sexual production

- 1- During the life cycle of sexually reproducing organisms, diploid germ cell produces haploid daughter cells which act as gametes under the process of meiosis.
- 2- Fusion of such haploid gametes thus maintain specific chromosome no. for each species.
- 3- Humans have 46 chromosomes in their somatic cells.
- 4- The haploid gametes formed by process of meiosis have 23 chromosome.
- 5- In fertilization process a 23 chromosomes of sperm fuses with egg also having 23 chromosomes.
- 6- The original chromosome no. is restored in zygote.

Mitosis

Meiosis

- | | |
|--|--|
| 1. It occurs in somatic cells. | 1. It occurs in germ line cells. |
| 2. Produces two daughter cell. | 2. Produces four daughter cell. |
| 3. Daughter cells produced are diploid. | 3. All daughter cells are haploid. |
| 4. Chromosomes are independent of each other. | 4. Homologous chromosomes form pairs with each other. |
| 5. Daughter cell became part of somatic body. | 5. Daughter cell form gametes. |
| 6. No chiasmata formation. | 6. Chiasmata are formed. |
| 7. No crossing over occurs in mitosis process. | 7. Crossing over take place in meiosis I. |
| 8. Daughter cells are genetically alike. | 8. Daughter cells are different from each other and parent cell. |
| 9. In some cases daughter cell can divide again. | 9. Gametes formed by meiosis cannot be divide further. |
| 10. Cell divides only once. | 10. Cell divides twice. |