**CELL CYCLE AND CELL DIVISION**

**POINTS TO REMEMBER :**

* **Cell cycle :** The sequence of events by which a cell duplicates its genome, synthesis the other constituents of the cell and eventually divides into two daughter cells.

**Phases of cell cycle :**

**Interphase :**

* **G1 Phase**: Cell metabolically active and grows continuously.
* **S Phase**: DNA synthesis occurs, DNA content increases from 2C to 4C.but the number of chromosomes remains some (2N).
* **G2 Phase**: Proteins are synthesized in preparation for mitosis while cell growth continues.
* **M Phase** (Mitosis Phase): Starts with nuclear division, corresponding to separation of daughter chromosomes (karyokinesis) and usually ends with division of cytoplasm (cytokinesis).
* **Quiescent stage (G0)**: Cells that do not divide and exit G1 phase to enter an inactive stage called G**0**. Cells at this stage remain metabolically active but do not proliferate.

**MITOSIS : It is equational division, were division of cell results into formation of two daughter cells.**

* **Prophase :** 
  + Replicated chromosomes, each consisting of 2 chromatids, condense and become visible.
  + Microtubules are assembled into mitotic spindle.
  + Nucleolus and nuclear envelope disappear.
  + Centriole moves to opposite poles.
* **Metaphase :** 
  + Spindle fibres attached to kinetochores (small disc-shaped structures at the surface of centromers) of chromosomes.
  + Chromosomes line up at the equator of the spindle to form metaphase plate.
* **Anaphase :** 
  + Centromeres split and chromatids separate.
  + Chromatids move to opposite poles.
* **Telophase :** 
  + Chromosomes cluster at opposite poles.
  + Nuclear envelope assembles around chromosome cluster.
  + Nucleolus, Golgi complex, ER reform.
* **Cytokinesis :** Is the division of protoplast of a cell into two daughter cells after Karyokinesis (nuclear division).
* **Animal cytokinesis :** Appearance of furrow in plasma membrane which deepens and joins in the centre dividing cell cytoplasm into two.
* **Plant cytokinesis :** Formation of new cell wall begins with the formation of a simple precursor − cell plate which represents the middle lamella between the walls of two adjacent cells.

**Significance of Mitosis :**

* Growth − addition of cells.
* Maintenance of surface/volume ratio.
* Maintenance of chromosome number.
* Regeneration.
* Reproduction in unicellular organism.
* Repair and wound healing.

**MEIOSIS :**

* Specialized kind of cell division that reduces the chromosome number by half, resulting in formation of 4 haploid daughter cells.
* Occurs during gametogenesis in plants and animals.
* Involves  two  sequential  cycles  of  nuclear  and  cell  division  called Meiosis I and Meiosis II.
* Interphase occurs prior to meiosis which is similar to interphase of mitosis except the S phase is prolonged.
* 4 haploid daughter cells are formed.

**Meiosis I -**

**Prophase I : Subdivided into 5 phases.**

**Leptotene :**

* Chromosomes make their as single stranded structures.
* Compaction of chromosomes continues.

**Zygotene :**

* Homologous chromosomes start pairing and this process of association is called **synapsis**.
* Chromosomal synapsis is accompanied by formation of **synaptonemal** **complex**.
* Complex formed by a pair of synapsed homologous chromosomes is called **bivalent** or **tetrad**.

**Pachytene :**

* Crossing over occurs between non-sister chromatids of homologous chromosomes.

**Diplotene :**

* Dissolution of synaptonemal complex occurs and the recombined chromosomes separate from each other except at the sites of crossing over. These X-shaped structures are called **chaismata.**

**Diakinesis :**

* Terminalisation of chaismata.
* Chromosomes are fully condensed and meiotic spindles assembled.
* Nucleolus disappears and nuclear envelope breaks down.

**Metaphase I :**

* Bivalent chromosomes align on the equatorial plate.
* Microtubules from opposite poles of the spindle attach to the pair of homologous chromosomes.

**Anaphase I:**

* Homologous chromosomes separate while chromatids remain associated at their centromeres.

**Telophase I :**

* Nuclear membrane and nucleolus reappear.
* Cytokinesis follows (diad of cells).

**Interkinesis :** Stage between two meiotic divisions. (Meiosis I and meiosis II)

**Meiosis II -**

**Prophase II**

* Nuclear membrane disappears.
* Chromosomes become compact.

**Metaphase II**

* Chromosomes align at the equator.
* Microtubules from opposite poles of spindle get attached to kinetochores of sister chromatids.

**Anaphase II**

* Simultaneous splitting of the centromere of each chromosome, allowing them to move towards opposite poles of the cell.

**Telophase II**

* Two groups of chromosomes get enclosed by a nuclear envelope.
* Cytokinesis follows resulting in the formation of tetrad of cells i.e., 4 haploid cells.

**Significance of Meiosis**

* Formation of gametes: In sexually reproducing organisms.
* Genetic variability
* Maintenance of chromosomal number: By reducing the chromosome number in gametes. Chromosomal number is restored by fertilisation of gametes.