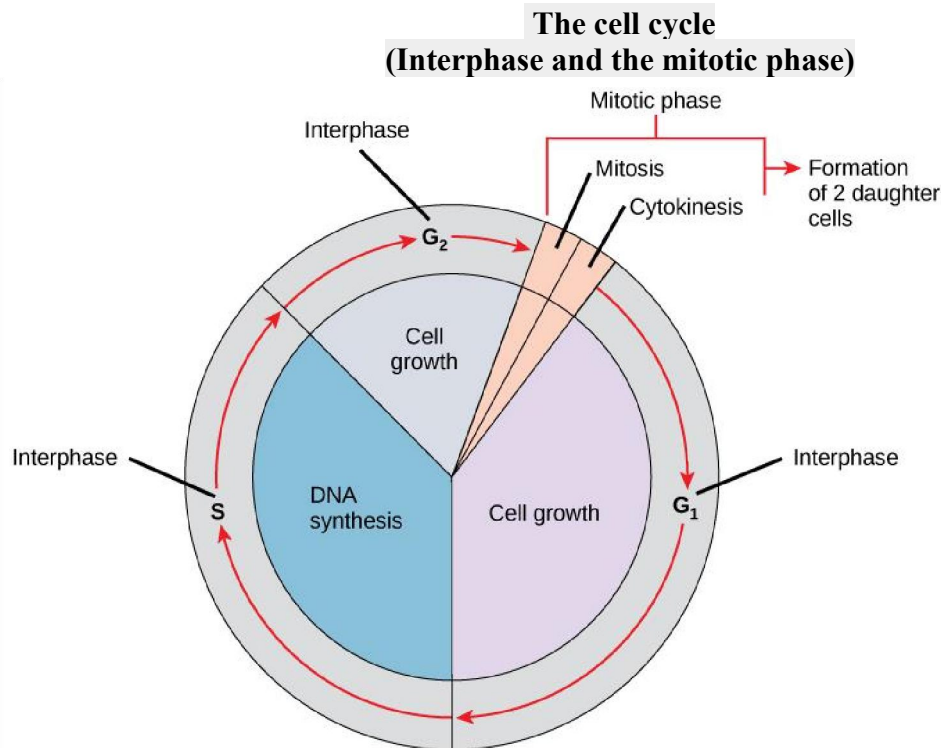


**Cell cycle (Interphase and Mitosis)** can be defined as the entire sequence of events happening from the end of one nuclear division to the beginning of the next. **Howard and Pelc (1953)** have divided cell cycle into four phases or stages : G<sub>1</sub>, S, G<sub>2</sub> and M phase. The G<sub>1</sub> phase, S phase and G<sub>2</sub> phase are combined to form the classical **interphase**.



**1. G<sub>1</sub> Phase.** After the M phase of previous cell cycle, the daughter cells begin G<sub>1</sub> of interphase of new cell cycle. G<sub>1</sub> is a First gap phase or resting phase. It is called **first gap phase**, since no DNA synthesis takes place during this stage; currently, G<sub>1</sub> is also called **first growth phase**, since it involves synthesis of RNA, proteins and membranes which leads to the growth of nucleus and cytoplasm of each daughter cell towards their mature size. Thus, G<sub>1</sub> involves transcription of three types of RNAs, namely rRNA, tRNA and mRNA ; rRNA synthesis is indicated by the appearance of nucleolus in the interphase (G<sub>1</sub> phase) nucleus. Proteins synthesized during G<sub>1</sub> phase (1) regulatory proteins which control various events of mitosis ; (2) enzymes (*e.g.*, DNA polymerase) necessary for DNA synthesis of the next stage ; and (3) tubulin and other mitotic apparatus proteins.

**2. S phase.** During the S phase or **synthetic phase** of interphase, replication of DNA and synthesis of histone proteins occur. New histones are required in massive amounts immediately at the beginning of the S period of DNA synthesis to provide the new DNA with nucleosomes. Thus, at the end of S phase, each chromosome has two DNA molecules and a duplicate set of genes.

**3. G2 phase.** This is a **second gap** or **growth phase** or resting phase of interphase. During G2 phase, synthesis of RNA and proteins continues which is required for cell growth. As the G2 phase draws to a close, the cell enters the M phase.

Division of nucleus is called as karyokinesis and division of cytoplasm is called cytokinesis.

The cell division is of two types. 1) Mitosis and 2) Meiosis

**MITOSIS:** The term mitosis was coined by Flemming in 1882. Mitosis occurs in somatic organs like root tip, stem tip and leaf base etc. Hence it is also known as somatic cell division. The daughter cells are similar to the mother cell in shape, size and chromosome complement. Since the chromosome number is same in the daughter cells as compared to that of mother cell, this is also known as homotypic or equational division. Mitotic cell cycle includes the following stages: Interphase: This is the period between two successive divisions. Cells in interphase are characterized by deeply stained nucleus that shows a definite number of nucleoli. The chromosomes are not individually distinguishable but appear as extremely thin coiled threads forming a faintly staining network. The cell is quite active metabolically during interphase.

**Mitosis consist of four stage, viz.,**

(a) Prophase, (b) Metaphase, (c) Anaphase and (d) Telophase

a) **Prophase:** This is the longest phase in mitosis. The nucleus takes a dark colour with nuclear specific stains and also with acetocarmine / orcein. The size of the nucleus is comparatively big and the chromosomes that are thin thread and uncoiled in the initial stages slowly thicken and shorten by a specific process of coiling called relational coiling. An important feature of prophase is that the two chromatids of each chromosome are held at centromere and can be seen under light microscope. The nuclear membrane and nucleolus disintegrates at the end of prophase and before the cell enters into metaphase.

b) **Metaphase:** After the disintegration of nuclear membrane in prophase, the spindle fibres are formed and the centromere of each chromosome is arranged on the equatorial plate. The chromosomes remain attached to spindle fibres at the centromere. This type of orientation of centromeres on the equator is known as auto-orientation. The chromosomes at this stage are shortest and thickest. Hence, chromosomes are clearly visible in metaphase. The chromatids of a chromosome are held together at the point of centromeres and the relational coils are at its minimum.

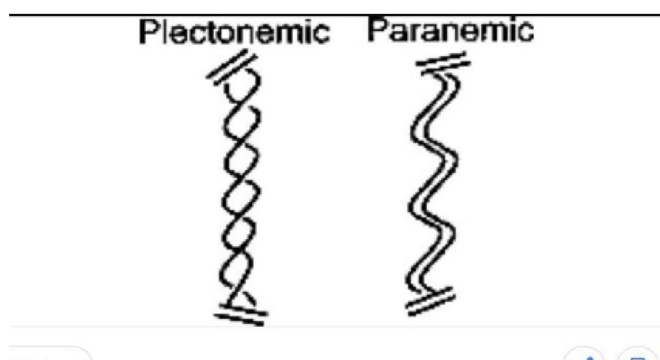
c) **Anaphase:** The centromere of each chromosome separates first and the sister chromatids or daughter chromosomes of each chromosome moves towards opposite poles due to contraction of spindle fibres. Depending on the position of the centromeres (metacentric, acrocentric and telocentric), the chromosomes show 'V', 'L' and 'I' shapes respectively as the anaphase progresses. The chromosome number is constant but the quantity of each chromosome is reduced to half.

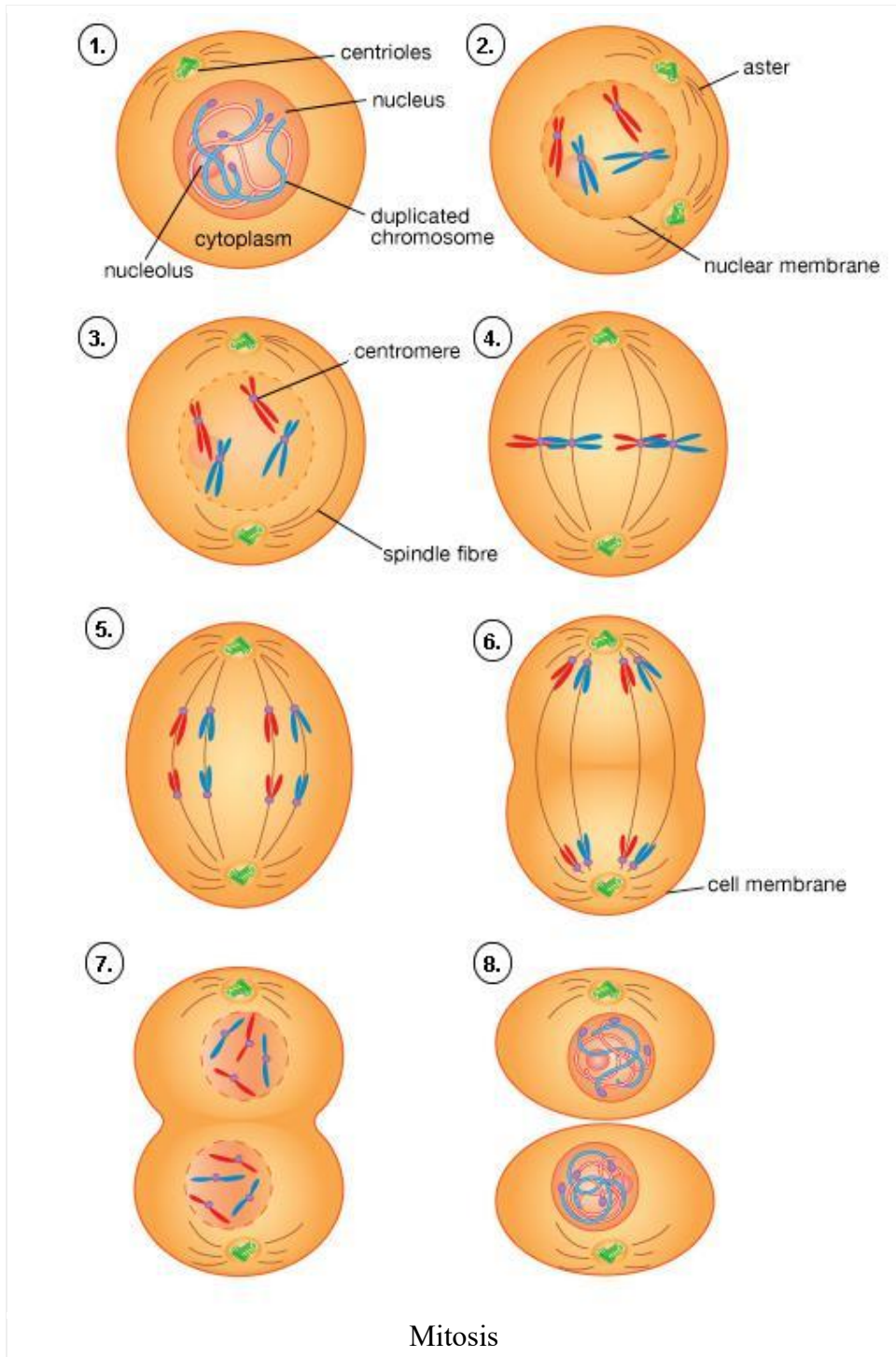
d) **Telophase:** spindle fibres disintegrate. Chromosomes lose their identity and become a mass of chromatin. The nucleus along with nucleoli will be re-organized at each pole. The division of one nucleus into two is known as Karyokinesis. Karyokinesis is followed by cytokinesis. Cytokinesis: It is the division of cytoplasm that usually occurs between late anaphase and end of telophase. In plants, cytokinesis takes place through the formation of cell plate by golgi apparatus, which begins in the centre of the cell and moves towards the periphery in both sides dividing the cytoplasm into two daughter cells. In animal cells, cytokinesis occurs by furrowing of plasmalemma in the equatorial region.

**Significance of Mitosis:** Mitosis plays an important role in the life of living organisms in various ways as given below:

1. Mitosis is responsible for development of a zygote into adult organism after the fusion of male and female gametes.
2. Mitosis is essential for normal growth and development of living organisms. It gives a definite shape to a specific organism.
3. In plants, mitosis leads to formation of new organs like roots, leaves, stems and branches. It also helps in repairing of damaged parts.
4. In animals, mitosis acts as a repair mechanism wherein old, dead and decayed cells are replaced with new ones, such as gut epithelium and blood cells
6. Mitosis is useful in maintaining the genetic purity because it does not allow segregation and recombination to occur. Hence daughter cells are genetically identical to parental ones. This concept forms the basis in asexual propagation of vegetatively propagated crops like sugarcane, banana, sweet potato, potato, etc. as mitosis leads to production of identical progeny in such crops.

Note: In plectonemic coiling as seen in mitotic prophase only, the two sister chromatids are wrapped around each other in a helix. The two chromatids cannot separate until uncoiling is completed. In paranemic coiling (as in parallel) of meiotic prophase the two strands simply lie alongside one another, making them easier to pull apart.





1. Interphase
2. Early Prophase
3. Late Prophase
4. Metaphase
5. Early Anaphase
6. Late Anaphase
7. Telophase
8. Daughter cell Identical

1. Interphase 2: Early Prophase 3. Late Prophase 4. Metaphase  
 5. Early Anaphase 6. Late Anaphase 7. Telophase 8. Daughter cell Identical