

# Mitosis and Meiosis

**Cell Continuity** -is the unbroken succession of cells since life evolved 3.8 billion years ago.

- New cells can only be produced by cell division.
- New cells are needed for
  - reproduction,
  - formation of multicellular organisms, and
  - cell replacement.

## Cell Cycle

There are three stages of the cell cycle:

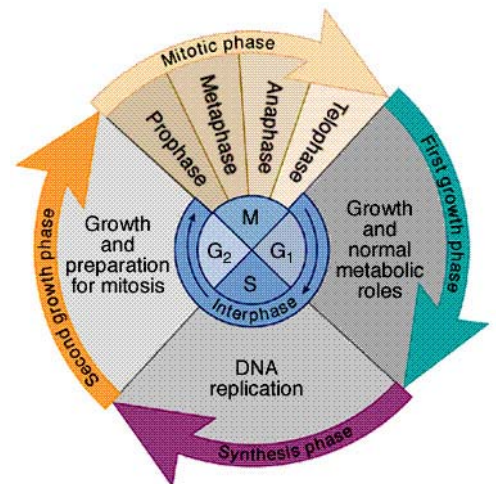
**1. Interphase** -The cell grows, proteins are made, the number of organelles increases, DNA replication.

**2. Division of the Nucleus:**

- **Mitosis:** two daughter nuclei, genetically identical the original nucleus, are formed.
- **Meiosis:** formation of four haploid genetically different daughter nuclei from the original diploid nucleus.

**3. Cytokinesis:**

- The cytoplasm divides between the new daughter nuclei.
- Therefore each nucleus with its allocation of cytoplasm becomes a new cell.



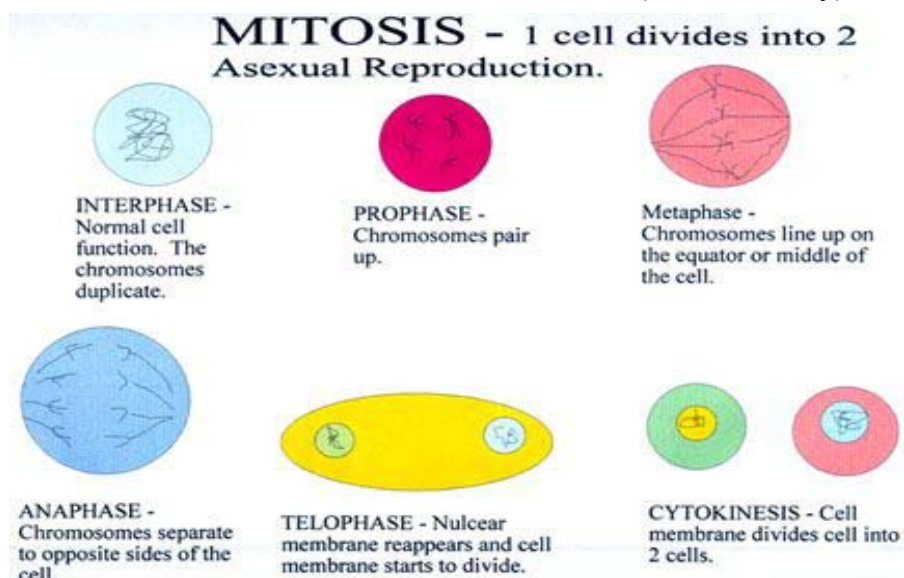
## Mitosis

All nuclei can undergo mitosis.

- **Haploid** (n): one set of chromosomes is present in the nuclei (i.e. only one of each different chromosome is present.)
- **Diploid** (2n): two sets of chromosomes are present in the nuclei (i.e. two of each different chromosome are present.)

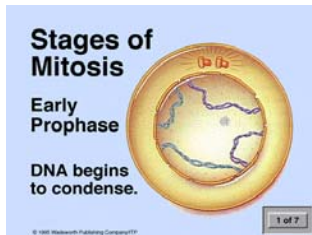
## Role of Mitosis

- Formation of a multicellular organism.
- Asexual reproduction e.g. Amoeba, yeast and vegetative reproduction of plant.
- Cell replacement and regeneration.
- Faithful copying of genes and their transfer to the next generation of nuclei or cells.
- Maintains the correct chromosome number of **somatic** (= normal body) cells.



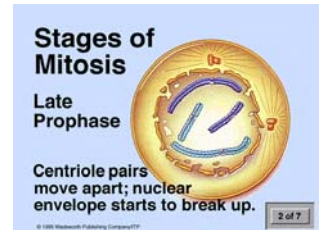
**Stages of Mitosis** (Interphase); Metaphase, Anaphase, Telophase. (Interphase)  
*(Mnemonic – I Pee MAT)*

**Prophase**



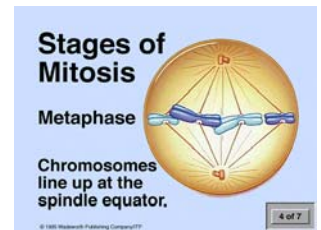
prophase

- chromatin condenses forming chromosomes
- chromosomes **shorten, thicken, coil, dehydrate**
- each chromosome consists of two identical sister **chromatids**
  - connected at the **centromere**
- **centriole** divides – forming the **spindle fibres**
- nuclear envelope breaks down at the end of



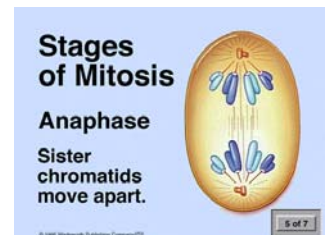
**Metaphase**

- chromosomes placed individually along the equator of the cell
- each chromosome is connected by two sets of spindle fibres attached to the centromeres



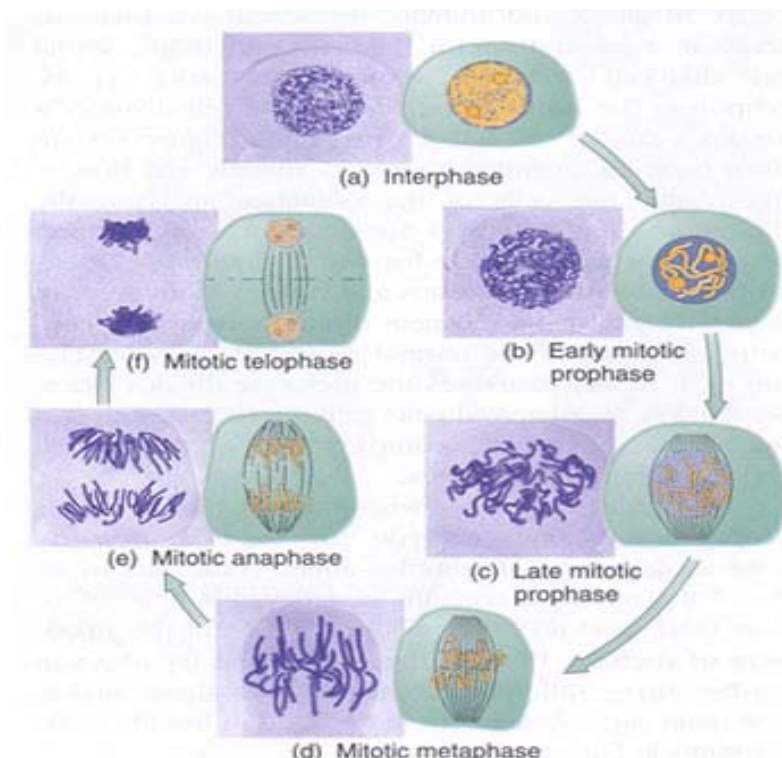
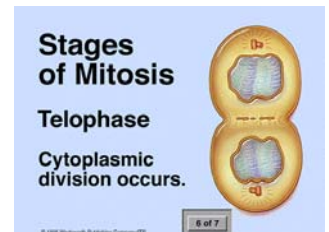
**Anaphase**

- separation of sister chromatids, **now termed chromosomes**
- the centromeres spit when the spindle fibres shorten
- shortening results in two identical sets of chromosomes at opposite sides of the cell



**Telophase**

- each chromosome group becomes a nucleus when a nuclear envelope is formed around it
- the chromosomes uncoil to chromatin
  - chromosomes **lengthen, uncoil, rehydrate**



## Definitions

**Chromatin:** DNA in its 'normal', i.e. functional state — condenses to form chromosomes.

**Chromosomes:**

- condensed chromatin showing up as a group of short thread-like structures
- **only** visible with the light microscope in nuclei during mitosis and meiosis
- each chromosome carries a specific set of genes in linear order at particular **loci** (= sites)

**Chromatid:**

- often described as '*half a chromosome*'
- it is one of two threads of condensed chromatin forming one chromosome
- the two threads are connected together at the **centromere** after DNA replication (**S phase**)
- they exist **only** during prophase and metaphase (i.e. *when chromosomes are X-shaped*)

**Centromere:** a non-DNA region of a chromosome where sister chromatids are held together and spindle fibres attach.

## Meiosis

**Meiosis:** the division of a diploid nucleus to form four haploid genetically different daughter nuclei.

**Role of Meiosis**

- Increases genetic variation in the population – role in evolution
- Makes sexual reproduction possible
- Gamete formation in animals, fungi, protocista e.g. Man

**Site of Meiosis**

**Animals**

- testis - forming sperm, the haploid male gametes;
- ovary - forming egg cells, the haploid female gametes.

**Flowering plants:**

- anther of the stamen - forming the haploid male spores (microspores),
- ovule of ovary - forming the haploid female spores (megaspores).

