

## Cell Division

### Introduction

In animals and most plants, chromosomes from the body cells exist in pairs. The two similar-looking chromosomes that form a pair are called **homologous chromosomes**.

Such body cells are **diploid (2n)**, as they have two sets of chromosomes and chromosomes occur in pairs.

In humans, body cells have, in total, 46 chromosomes. The body cells divide by the process of **mitotic cell division**. In mitotic cell division, each cell divides to form daughter cells of identical genetic composition to the parent cell.

Gametes or the sperm and egg cells, are **haploid (n)** as they have only one set of chromosomes. The gametes are formed by a process called **meiotic cell division**, where a diploid parent cell divides to form four haploid daughter cells (gametes), of different genetic composition. Two gametes fuse to form zygote, which divides by mitosis to form a human body.

### Cell division

- In bacteria and archaea (prokaryotes) the cell division is called **binary fission**. (fig.1)
- There are two types of cell division in eukaryotic cells: **Mitotic cell division** and **Meiotic cell division**.

**Mitotic cell division:** 1 cell (2n) or (n) → 2 cells (2n) or (n)

1. Occurs in diploid or haploid cells
2. Provides growth and repair for the multi-cellular organism and serves as means of asexual reproduction in unicellular and some multi cellular eukaryotic organisms.
3. Results in two cells
4. Produces cells of the same genetic composition

**Meiotic cell division:** 1 cell (2n) → 4 cells (n)

1. Occurs only in diploid cells
2. Produces gametes by a process called spermatogenesis or oogenesis (in most animals) and spores by sporogenesis (in plants).
3. Results in four haploid cells
4. Produces cells that are genetically different and contain half the number of chromosomes of parent cells.
5. Consists of two successive divisions but one chromosome replication.

### Cell cycle

A eukaryotic cell passes through a cell cycle that consists of **interphase** and **cell division** (mitotic or meiotic).fig.2

- **Interphase**—(90% of cycle)
  1. G1 stage—first growth period
  2. S stage—synthesis of DNA or chromosome replication (Replicated chromosome contains two sister chromatids joined at the centromere fig.3)
  3. G2 stage—second growth period
- **A mitotic cell division involves mitosis (nuclear division) and cytokinesis (division of cytoplasm).**

### **Phases of mitosis (fig. 5, 6 & 7)**

Prophase: nuclear membrane and nucleolus disappear, chromosomes start condensing

Metaphase: chromosomes line up at the equator of cell

Anaphase: sister chromatids separate; a cell contains two complete sets of chromosomes

Telophase: nuclear membrane and nucleolus reappear; cytokinesis (division of cytoplasm) begins

Plant cells form cell plate (fig.5 Telophase)

Animal cells form cell furrow (fig.4 Telophase)

Cancers result from cell division that is out of control.

- **A meiotic cell division involves meiosis (nuclear division) and cytokinesis (division of cytoplasm).**

**Phases of meiosis-** includes two successive cell divisions (fig.8)

Meiosis I                      Meiosis II

Prophase I                    Prophase II

Metaphase I                 Metaphase II

Anaphase I                 Anaphase II

Telophase I                 Telophase II

In the interphase between meiosis I and II, there is no synthesis of DNA

### **Assignment 2:**

Observe different phases of mitosis in animal cells using prepared slide of white fish blastula.

Observe different phases of mitosis in plant cells using prepared slide of onion root tip.

### **Assignment 3:**

Use beads to represent chromosomes and simulate replication and distribution of chromosomes in both mitosis and meiosis.

### **Assignment 4:** Study Table 1

**Assignment 5:** Identify the stage of cell division in the slides mounted for you.

- Observe additional slides showing meiosis (i.e. spermatogenesis and oogenesis on the back bench).
- Observe the cell models showing different phases of cell cycle.