# The Fundamental Unit of Life Chromosomes and Cytoplasm

## Chromosome

"A Chromosome looks like a thread and is coiled material, made of proteins. Chromosomes are present in the nucleus of all the cells and contain the basic genetic material DNA, which passes from one generation to another"

## Structure:

A chromosome has generally 8 parts; Centromere or primary constriction or kinetochore, chromatids, chromatin, secondary constriction, telomere, chromomere, chromonema, and matrix.

- **Centromere or Kinetochore**: It is the primary constriction at the center to which the chromatids or spindle fibers are attached. Its function is to enable movement of the chromosome during the anaphase stage of cell division.
- **Chromatid:** During cell division, a chromosome is divided into 2 identical half strands joined by a centromere. A chromatid is each half of the chromosome joined. Each chromatid contains DNA and separates at Anaphase to form a separate chromosome. Both chromatids are attached to each other by the centromere.
- **Chromatin:** It is a complex of DNA and proteins that forms chromosomes within the nucleus of eukaryotic cells. Nuclear DNA is highly condensed and wrapped around nuclear proteins in order to fit inside the nucleus. In other words, it is not present as free linear strands. The chromatin consists of DNA, RNA, and protein.
- Secondary Constriction: It is generally present for the nucleolar organization.
- **Telomere:** Telomere is the terminal region of each side of the chromosome. Ach chromosome has 2
- **Chromonema:** It is a threadlike coiled filamentous structure along which chromomeres are arranged. Chromonema controls the size of the chromosome and it acts as a site of gene bearing.

- **Chromomeres:** These are the bead-like structures present on threads or chromonema. These are arranged in a row along the length of chromonema. The number of chromosomes is constant and it is responsible for carrying the genes during cell division to the next generation.
- **Matrix:** Pellicle is the membrane surrounding each of the chromosomes. Matrix is the jelly-like substance present inside pellicle. It is formed of non-genetic materials.

#### **Functions of Chromosomes**

For the first time, Sutton and Bover suggested the role of chromosomes in heredity in 1902.

- The most important function of chromosomes is to carry the basic genetic material DNA. DNA provides genetic information for various cellular functions. These functions are essential for growth, survival, and reproduction of the organisms.
- Histones and other proteins cover the Chromosomes. These proteins protect it from chemical (e.g., enzymes) and physical forces. Thus, chromosomes also perform the function of protecting the genetic material (DNA) from damage during the process of cell division.
- 3. During cell division, spindle fibers attached to the centromeres contract and perform an important function. The contraction of centromeres of chromosomes ensures precise distribution of DNA (genetic material) to the daughter nuclei.
- Chromosomes contain histone and non-histone proteins. these proteins regulate gene action. Cellular molecules that regulate genes work by activating or deactivating these proteins. This activation and deactivation expand or contract the chromosome.

## Examples of Types of Chromosomes

- **Metacentric Chromosomes:** Metacentric chromosomes have the centromere present exactly in the center. Both the sections are metacentric chromosomes are therefore of equal length. Example: Human chromosome 1 and 3 are metacentric.
- Submetacentric Chromosomes: In Submetacentric chromosomes, the centromere is not present exactly at the center. The centromere is slightly offset from the center. Both the sections are therefore not of equal length or are asymmetrical. Example: Human chromosomes 4 to 12 are submetacentric.
- Acrocentric Chromosomes: Acrocentric chromosomes have a centromere which is highly offset from the center. Therefore, one of the strands is very long and one very short. Example: Human chromosomes 13,15, 21, and 22 are acrocentric.

• **Telocentric Chromosomes:** In telocentric chromosomes, the centromere is present at the very end of the chromosome. Telocentric chromosomes are present in species such as mice. Humans do not possess telocentric chromosomes.

## Cytoplasm

The fluid that fills up the cells is referred to as the cytoplasm. It encompasses the cytosol with filaments, ions, proteins, and macromolecular structures and also other organelles suspended in the cytosol. But new research suggests that the traditional definition of cytoplasm is no longer valid. Decades prior, it was considered to be a fluid-like substance, but new evidence reveals that it is similar to glass-forming liquids. The cytoplasm in the **eukaryotic cells** associates with the cell contents except for the nucleus. But in prokaryotic cells, as they do not possess a defined nuclear membrane, the cytoplasm possesses the genetic material of the cell. The cells, in comparison to the eukaryotes, are smaller and have an uncomplicated arrangement of the cytoplasm.

### **Historical Account:**

In the year 1665, Robert Hooke, an English researcher observed the fundamental unit of life through his coarse compound microscope. He coined the term "cell", which was based on the Latin word called "Cella," meaning, small rooms.

Later, many scientists contributed to Robert Hooke's findings and eventually, the Cell Theory was postulated. As technology progressed, modern interpretations of Cell Theory have been formed, with new tenets and revisions of the existing ones.

In 1863, a Swiss biologist named Rudolf von Kolliker coined the term "Cytoplasm," but it was regarded as a synonym for protoplasm. However, the term gradually changed its meaning to the current definition of the term "cytoplasm".

#### Structure :

Cell organelles are various structures existing inside cells. All these structures are distinct and perform specific functions. Cells have three main elements i.e., plasma membrane, and cytoplasm and the nucleus.

The plasma membrane or cell membrane is a bi-lipid membranous layer, parting the cell organelles from its outside environment and from the different cells. It is the external covering of a cell where all different parts, including cytoplasm and nucleus, are enclosed.

Next, is the nucleus, one of the biggest organelle. They have exclusive control of a cell. Lastly, the cytoplasm is a jelly-like material in which the cell organelles are implanted.

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The cytoplasm is an essential component of the cell. It is a semi-liquid jelly-like material, which joins the nucleus and the cell membrane. In the cell, the cytoplasm is embedded, while other cell organelles such as endoplasmic reticulum, mitochondria, ribosomes, vacuoles, etc. are all suspended within It can easily be examined under a microscope through the staining technique. Functionally, it is the site for several chemical reactions within a cell. Most of the cellular metabolism takes place here.



# Function

One of the major functions of cytoplasm is to enable cells to maintain their turgidity, which enables the cells to hold their shape. Other functions of cytoplasm are as follows:

- The jelly-like fluid of the cytoplasm is composed of salt and water and is present within the membrane of the cells and embeds all of the parts of the cells and organelles.
- The cytoplasm is home to many activities of the cell as it contains molecules, enzymes that are crucial in the breakdown of the waste.
- The cytoplasm also assists in metabolic activities.
- Cytoplasm provides shape to the cell. It fills up the cells thus enabling the organelles to remain in their position. The cells, without cytoplasm, would deflate and substances will not permeate easily from one to the other organelle.
- A part of the cytoplasm, the cytosol has no organelles. Rather, the cytosol is enclosed by matrix boundaries that fill up the cell section which does not hold the organelles.

The whole cellular content of a living cell is called protoplasm. The cytoplasm, nucleus and all other living components of the cell together make up the protoplasm of a cell.