CHROMOSOMES

Definition of 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".

In the nucleus of each cell, the **DNA** molecule is packaged into thread-like structures called chromosomes.

Each chromosome is made up of DNA tightly coiled many times around proteins called histones that support its structure.

They appear as rod shaped dark stained bodies during the metaphase stage of mitosis when cells are stained with a suitable basic dye and viewed under a light microscope.

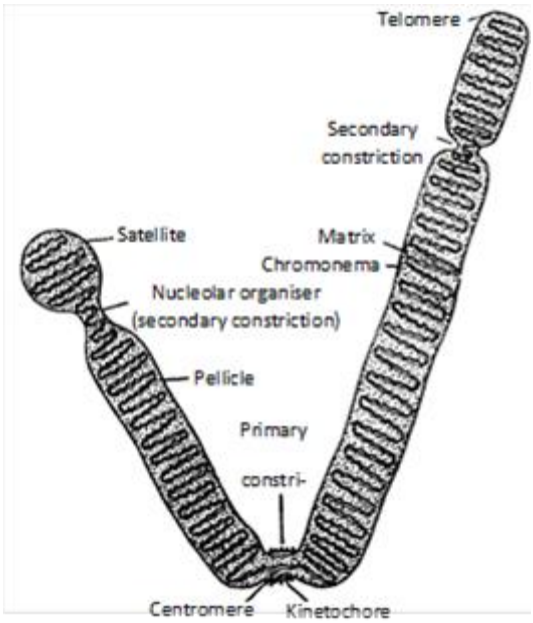


Fig : Structure of chromosome

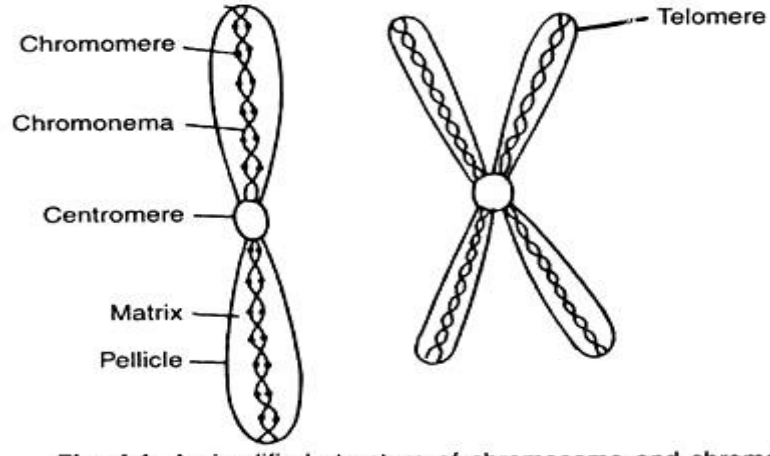
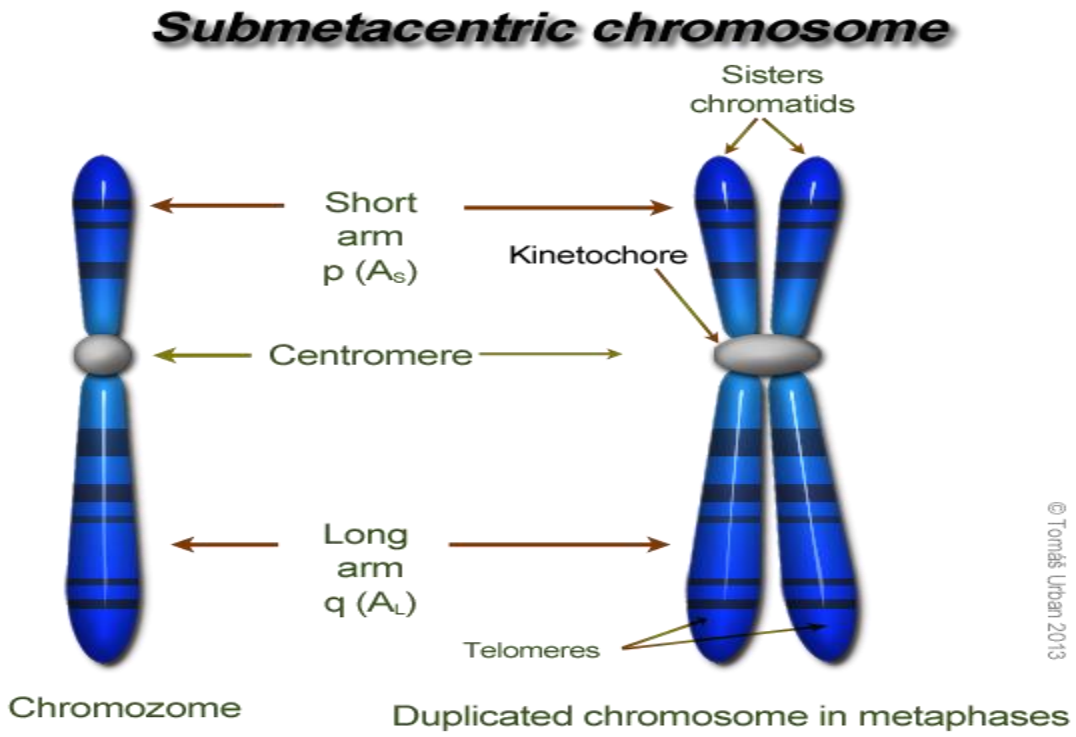


Fig. 4.1. A simplified structure of chromosome and chromatid.



Chromosomes 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.

Shape at Anaphase

a. V Shaped Chromosome:
A chromosome which assumes V shape at anaphase. It includes metacentric chromosome.
b. J Shaped Chromosome:
A chromosome which assumes J shape at anaphase. It includes sub-metacentric and sub-terminal chromosomes.

c. Rod Shaped Chromosome:

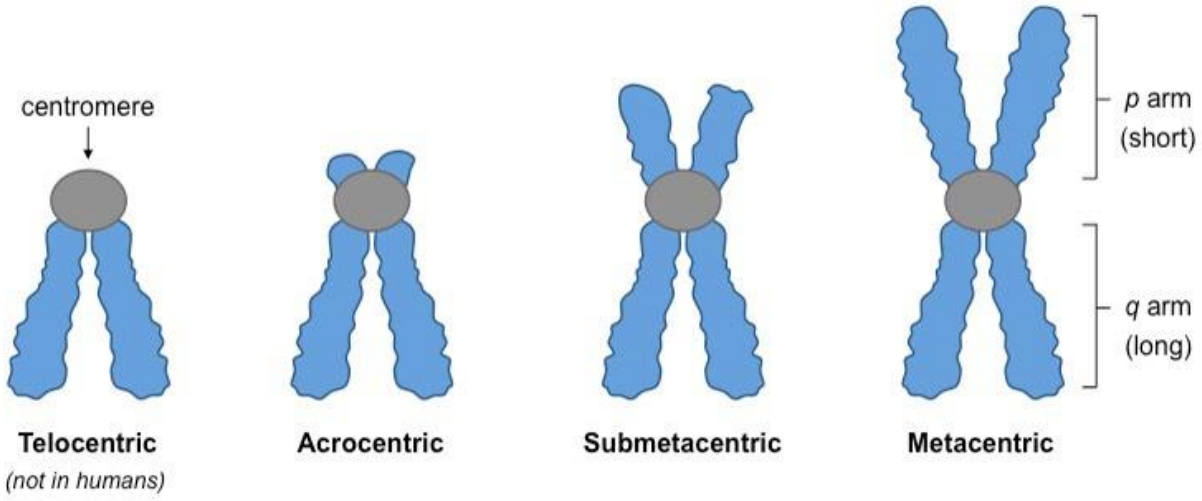
Based on sex

- Human chromosomes are of two types autosomes and sex chromosomes.
- Genetic traits that are linked to the sex of the person are passed on through the sex chromosomes. The rest of the genetic information is present in the autosomes.
- Humans have 23 pairs of chromosomes in their cells, of which 22 pairs are autosomes and one pair of sex chromosomes, making a total of 46 chromosomes in each cell.

On th basis of number of centromere

1. **Monocentric** with one centromere.
2. **Dicentric** with two centromeres.
3. **Polycentric** with more than two centromeres
4. **Acentric** without centromere. Such chromosomes represent freshly broken segments of chromosomes which do not survive for long.
5. **Diffused or non-located** with indistinct centromere diffused throughout the length of chromosome.

On the basis of Location



1. **Telocentric** are rod-shaped chromosomes with centromere occupying the terminal position, so that the chromosome has just one arm.
2. **Acrocentric** are also rod-shaped chromosomes with centromere occupying a sub-terminal position. One arm is very long and the other is very short.
3. **Sub-metacentric** chromosomes are with centromere slightly away from the mid-point so that the two arms are unequal.
4. **Metacentric** are V-shaped chromosomes in which centromere lies in the middle of chromosome so that the two arms are almost equal.

Functions and Significance of Chromosomes

1. The number of the chromosomes is constant for a particular species. Therefore, these are of great importance in the determination of the phylogeny and taxonomy of the species.
2. **Genetic Code Storage**: Chromosome contains the genetic material that is required by the organism to develop and grow. DNA molecules are made of chain of units called genes. Genes are those sections of the DNA which code for specific proteins required by the cell for its proper functioning.
3. **Sex Determination:** Humans have 23 pairs of chromosomes out of which one pair is the sex chromosome. Females have two X chromosomes and males have one X and one Y chromosome. The sex of the child is determined by the chromosome passed down by the male. If X chromosome is passed out of XY chromosome, the child will be a female and if a Y chromosome is passed, a male child develops.
4. **Control of Cell Division:** Chromosomes check successful division of cells during the process of mitosis. The chromosomes of the parent cells insure that the correct information is passed on to the daughter cells required by the cell to grow and develop correctly.
5. **Formation of Proteins and Storage:** The chromosomes direct the sequences of proteins formed in our body and also maintain the order of DNA. The proteins are also stored in the coiled structure of the chromosomes. These proteins bound to the DNA help in proper packaging of the DNA.