

~ Ultra structure of chromosome

Definition of Chromosome

Chromosomes were first described by Strasburger (1815), and the term 'chromosome' was first used by Waldeyer in 1888. In the nucleus of each cell, the DNA molecule is packaged into thread-like structures called chromosomes or During cell division, the material of the nucleus became organized into visible "threads," which were named chromosomes, meaning "colored bodies."

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.

Structure of chromosome

In eukaryotes the chromosomes are multiple large, linear and are present in the nucleus of the cell. Each chromosome typically has one centromere and one or two arms that project from the centromere. Structurally, each chromosome is differentiated into three parts—

1. Pellicle
2. Matrix
3. Chromonemata

Pellicle

- a) It is the outer envelope around the substance of chromosome.
- b) It is very thin and is formed of achromatic substances.

Matrix

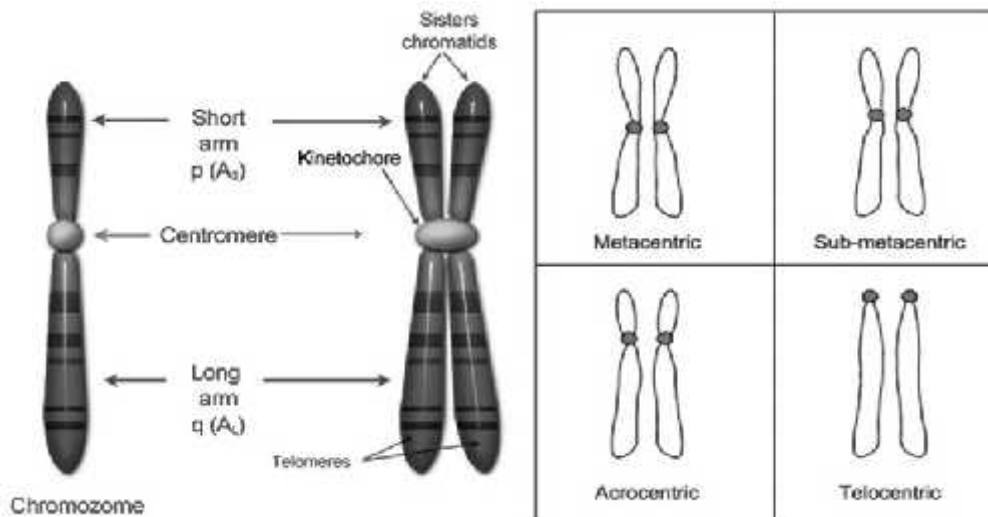
- a) It is the ground substance of chromosome which contains the chromonemata.
- b) It is also formed of non-genic materials.

Chromonemata

- a) Embedded in the matrix of each chromosome are two identical, spirally coiled threads, the chromonemata.
- b) The two chromonemata are also tightly coiled together that they appear as single thread of about 800Å thickness.
- c) Each chromonemata consists of about 8 microfibrils, each of which is formed of a double helix of DNA.

In mitotic metaphase chromosomes, the following structural feature (except chromomere) can be seen under the light microscope:

- (1) Chromatid,
- (2) Chromonema,
- (3) Chromomeres,
- (4) Centromere,
- (5) Secondary constriction or Nucleolar organizer,
- (6) Telomere and
- (7) Satellite.



Centromere

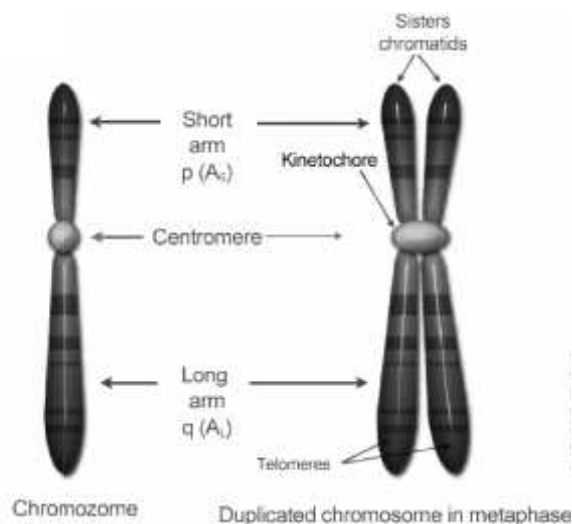
- a) A small structure in the chromonema, marked by a constriction which is recognised as permanent structure in the chromosome is termed as the centromere.
- b) At this point the two chromonemata are joined together.
- c) It is known as centromere or kinetochore or primary constriction.
- d) It divides the chromosome into two sections, or "arms." The short arm of the chromosome is labeled the "p arm." The long arm of the chromosome is labeled the "q arm."
- e) Its position is constant for a given type of chromosome and forms a feature of identification.
- f) In thin electron microscopic sections, the kinetochore shows a trilaminar structure, i.e., a 10 nm thick dense outer proteinaceous layer, a middle layer of low density and a dense inner layer tightly bound to the centromere.
- g) The chromosomes are attached to spindle fibres at this region during cell division.

Secondary Constriction or Nucleolar Organiser

- The chromosome besides having the primary constriction or the centromere possesses secondary constriction at any point of the chromosome.
- Constant in their position and extent, these constrictions are useful in identifying particular chromosomes in a set.
- The chromosome region distal to the secondary constriction i.e., the region between the secondary constriction and the nearest telomere is known as satellite.
- Therefore, chromosomes having secondary constrictions are called satellite chromosomes or sat-chromosomes.
- Nucleolus is always associated with the secondary constriction of sat-chromosomes. Therefore, secondary constrictions are also called nucleolus organiser region (NOR) and sat-chromosomes are often referred to as nucleolus organiser chromosomes.

Telomere

- These are specialized ends of a chromosome which exhibits physiological differentiation and polarity.
- Each extremity of the chromosome due to its polarity prevents other chromosomal segments to be fused with it. The chromosomal ends are known as the telomeres.
- If a chromosome breaks, the broken ends can fuse with each other due to lack of telomere.



Submetacentric Chromosome

Above images taken from google