RAMA UNIVERSITY

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# FACULTY OF AGRICULTURAL SCIENCES AND ALLIED INDUSTRIES

## CHROMOSOME STRUCTURE AND FUNCTION

Chromosomes are rod shaped, dark stained bodies seen during metaphase. The term 'chromsome' was first used by Waldeyer in 1888. (Chrom- coloured soma =body), deeply stained, while cytoplasm remained unstained. Each speceies has a definite chromosome number. Each species has a definite chromosome number, represented by 2n. Somatic cells

contains two copies of each chromosomes, which are identical in morphology, gene content and gene order and they are known as homologous chromosomes. Gametic chromosome number is precisely one half of the somatic number, is represented by 'n' zygote is produced by fusion of one male and one female gamete (n+n=2n).

### MOROPHOLOGY

Cell division, the following structural features can be seen under light microscope by staining.

1. Chromatid
2. Centromere
3. Telomere
4. Secondary constriction and satelite
5. Chromosome

### CHROMATID

It is the structural and functional unit of chromosomes. At Metaphase, each chromosome appears to the longitudinally divided into two identical parts, each of which is known a 'Chromotid'. The chromatids of a chromosome appear to joined the giller at a point called 'centromere'. The two chromatid making up a chromosome are produced through replication of a single chromatid, they are referred as 'Sister chromatids'. In contrast the chromatrids of homologous chromosomes are known as non-sister chromatids.

### CENTROMERE

The region where thre two sister chromatids of a chromosome appeared to held together is known as 'centomere' under light microscope, centomere generally appears as a constriction in the chromosome, hre it is also termed as 'primary constriction'.

Centromeres are the first part moving towards the opposite poles during anaphase; the remaining regions lag behind and appear as if they wree being pulled by the centomere. Therefore, chromosome movement is due to the centromeres of chromosomes hence they are also known as 'Kinetochoes'.

In most speceis each chromosome has a single centromere in a fixed position which does not change except due to structural chromosome abernations. Therefore, the position of centromere serves as an important land mark in the identification of different chromosomes of a species. Each chromosomes is divided into two transverse parts by its centimre; these parts are called 'Arms'. On the basis of the position of centromere, the chromosome may be divided into your classes.

i. **Metacentric** - Cntremere is at the centre of chromosome having equal arms and appeared as 'V' shaped during anaphase.
ii. **Submeta centric chromosoem** - Centromere is on one side called 'Submedian. 'V' or 'J' shaped during anaphase.
iii. **Actocentric** - When centromere is located close to one end, they are called as "Sub terminal 'j' or rod shaped.
iv. **Telo centric** - Occasionally, the centromere appeared to be at one end of the chromosome, called as 'Terminal' Rod shaped during anaphase. They are unstable.

In most species each chromosomes has a single centromere such chromosomes are termed as'Monocentric'. But in some speceis each chromosomes as 'Poly centric'- Polycentric chromosomes often break into smaller chromosomal units each of which is stable and functions normally.

Centromeres, ccontain highly repetitive DNA called "Satellite -DNA" or "Sat-DNA", distinct from the rest of the Chromosomal DNA. It constitutes about10% of total DNA present in the genome. In many species Sat-DNA consists of only one sequence, while in others more thanone distinct sequences are found.

**TELOMERE**

The two ends of a chromosomes are known as'Telomeres'. They are highly stable and do not fuse with other chromosomes. It is generally accepted that, the structural integrity and individuality of chromosomes is maintained due to the telomeres and that all stable chromosome ends are composed of telomeres.

**SECONDARY CONSTRICTION AND SATELITE**

In some chromosomes a sconed constriction, in addition to that due to centromere (primary constriction) is also present. It is known as "Secondary constriction). It is present in short arm near one end, or in many chromosomes they are located in the long arm nearer to the centromere. The region between the secondary constriction and the nearest telomere is known as satellite. Therefore, chromosomes having secondary constitution are called " Satellite Chromosome" or "Sat -Chromosomes. The position of secondary constriction in Sat-Chromsome is fixed and remains constant. The number of Sat-Chromosomes in the genome varies from one species to the other. The number of Sat. Chromosomes may ranged from

2,4,6 or 10, 13,14,15,21 and 22. Human somatic cells have 10 Sat Chromosomes. Nucleolus is always associated with the secondary constriction of Sat. Chromosomes. Therefore secondary constrictions are also called as"Nucleolus oraniser Region" (NOR) and Sat-Chromosomes are often referred as Nucelolus organism chromosome (NOC) NOR contains several hundred copies of the gene coding for ribosomal RNA. (r RNA).

**CHROMOSOME**

In some species (Maize, amphibia etc.,) chromosomes during Prophase I of meiosis, particularly during pachytene stage, show small head like structures called 'Chromomeres'. The distribution of chromomeres in a chromosome is highly characteristic and constant, the patterns of distribution being different for different chromosomes; homologous chromosomes show an identical pattern.

**KARYOTYPE**

The general morphology, i.e. the size of chromosomes, the position of centromeres, the presence of secondary constriction and the size of satelite bodies of the somatic chromosomes complement of an individual constitutes its "Karyotype".

It is represented by arranging the chromosomes in a descending order of size keeping their centromeres in a straight line. Each chromosome in the karyotype is designated by a serial number according to its position. A perfectly symmetrical karyotype has all metacentric chromosomes of the same size. Karyotypes showing a deviation from this stateare called asymmertical. It is believed that, perfectly symmetrical karyotypes represent a primitive state from which more advanced asymmetrical Karyotypes have evolved through structural changes in chromosomes.