# Quadrant II – Transcript and Related Materials

**Programme: Bachelor of Science (First Year)**

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**Paper Title: Diversity of Chordates and Genetics**

**Unit: 09**

**Module Name: Eukaryotic chromosome, Types of Eukaryotic Chromosomes based on Centromere position**

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**Notes :**

## Eukaryotic chromosome, types of Eukaryotic chromosome based on position of centromere

The chromosomes are the nuclear components of special organization, individuality and function. They are capable of self reproduction and play vital role in heredity, mutation, variation and evolutionary development of species.

**History:**

- **W. Fleming** (1879) first of all described the splitting of chromosomes and coined the term chromatin for stainable material of the nucleus.
- **W. Roux** (1883) suspected the involvement of the chromosomes in the mechanism of inheritance.
- **Benden and Bovery** (1887) reported that the number of chromosomes for each species was constant.
- The present name Chromosome (Gr., ***Chrom*-colour**, ***soma*-body**) was coined by **W.Waldeyer** (1888) to darkly stained bodies of nucleus.
- **W. S. Sutton** and **T. Boveri** in 1902 suggested that chromosomes were the physical structures which acted as messengers of heredity.
- **Morgan** (1933) discovered the function of chromosomes in transmission of heredity traits.
- **Heitz** 91935), **Kuwanda** (1939), **Geitter** (1940) and **Kaufman** 91948) have described the morphology of chromosomes.
- The molecular organisation of chromosomes has been recently worked out.

**Chromosome number:**
The number of chromosomes is constant for a particular species. Therefore, these are of great importance in determination of the phylogeny and taxonomy of the species.

**Haploid and diploid:**
The number and set of the chromosomes of the gametic cells such as sperm and ova is known as the gametic, reduced or **haploid** sets of chromosomes. The haploid set of chromosomes is also known as the **genome**. The somatic or body cells of most organisms contain two haploid sets or genomes and are known as the **diploid** cells. The diploid cells achieve the diploid set of chromosomes by the union of the haploid male and female gametes in the sexual reproduction.

**Size:**
The size of the chromosomes varies from species to species and relatively remains constant for a particular species. The length of the chromosomes may vary from **0.2** to **50 µm**. The diameter of chromosomes may be from **0.2** to **20 µm**.For instance, human chromosomes are up to 6 µm in length.
Organisms with less number of chromosomes contain comparatively large sized chromosomes than those having more number of chromosomes.
The chromosomes in a cell are never alike in size, some may be exceptionally large and other may be too small. The largest chromosomes are **Lampbrush** chromosomes of certain vertebrate oocytes and **Polytene** chromosomes of certain Dipteran insect.

**Shape**:
The shape of the chromosomes is changeable from phase to phase in the continuous process of the cell growth and cell division. In the resting phase or interphase stage of cell, the chromosomes occur in the form of thin, coiled, elastic and contractile, thread like stainable structures, the chromatin thread. In the metaphase and the anaphase, the chromosomes become thick and filamentous.Each chromosome contains a clear zone, known as centromere or kinetochore, along their length. The centromere divides the chromosomes into two parts, each part is called Chromosome arm.

**STRUCTURE OF EUKARYOTIC CHROMOSOME**

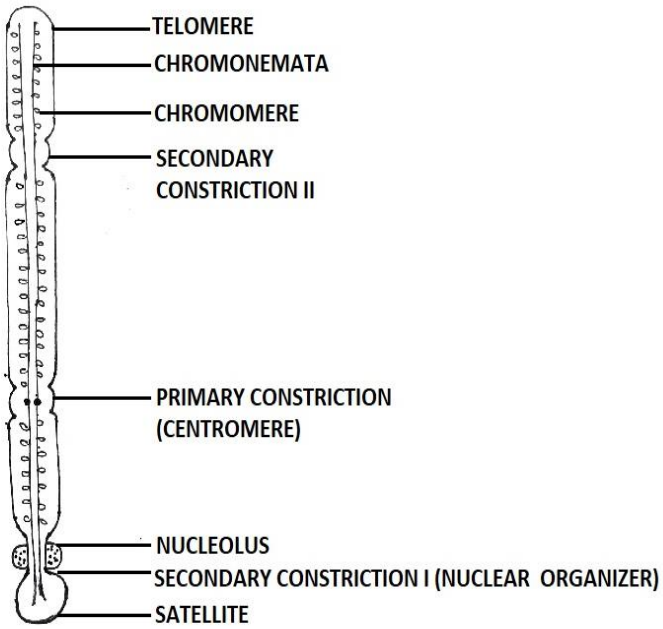
**Chromatid:** At mitotic metaphase each chromosome consists of two symmetrical structures, called Chromatids. Each chromatid contains a single DNA molecule. Both chromatids are attached to each other only by centromere and become separated at the beginning of anaphase, when sister chromatids of chromosome migrate to opposite poles.

**Chromonema**: A coiled filament is seen in the chromosome called as **Chromonema** (byVejdovsky in 1912). Chromonema may be composed of two, four or more fibres according to the species. Further, the number of threads in the chromonema may depend on the different phases because at one phase the chromonema may contain one thread and at other phase it may contain three or four threads. The thread or fibres of chromonema remain coiled with each other. The coils may be of the following two types:

**1) Paranemic coils**: when chromonemal threads are easily separable from their coils

**2)Plectonemic coils:** when chromonemal threads remain inter-twined so intimately that they cannot be separated easily.

**Structure of a typical Chromosome**




**Chromomeres**: The chromonema of thin chromosomes of mitotic and meiotic prophases have been found to contain alternating thick and thin regions and thus giving the appearance of necklace in which, several beads occur on a string. The thick or bead-like structures of the chromonema are known as the **chromomeres** and the thin region in between the chromomeres is termed as the **inter-chromomeres**. The position of chromomeres in the chromonema is found to be constant for a given chromosome.

**Centromere**:The shape of chromosome is determined by the **primary constriction** located at the point where the arms of a chromosome meet. Within the constriction is a clear zone containing a small granule or spherule. This clear region is the so called **Centromere** or **Kinetochore**.

The chromosomes of most organisms contain only one centromere and are known as **monocentric** chromosomes. Certain chromosomes may have two or more centromeres and can be termed as **dicentric** and **polycentric** chromosomes.

Secondary constriction play role in the formation of the nucleus, therefore known as the **nuclear zone** or **nucleolar organizers**.

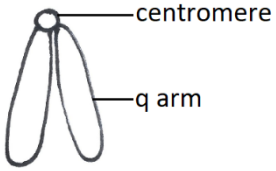
**Telomere**: Each extremity of the chromosome has a polarity and therefore it prevents other chromosomal segments to be fused with it. The chromosomal ends are known as **Telomere**.

**Satellite**: Sometimes the chromosomes bear round elongated or knob-like appendages known as **Satellites**. The satellite remains connected with the rest of the chromosome by a thin chromatin filament. The chromosomes with the satellite are designated as **Sat chromosome**. The shape and size of satellite remain constant.

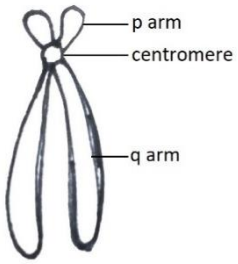
**TYPES OF EUKARYOTIC CHROMOSOMES BASED ON CENTROMERE POSITION**

The position of Centromere varies from chromosome to chromosome and it provides different shapes which are as following:

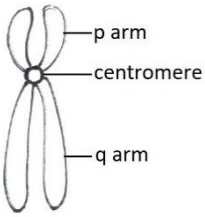
1. **Telocentric**: The rod-like chromosomes which have the centromere on the proximal end are known as the Telocentric chromosomes.




2. **Acrocentric**: The acrocentric chromosomes are also rod like in shape but these have the centromere at one end and thus giving a very short arm and an exceptionally long arm. The locusts (Acrididae) have the acrocentric chromosome.



3. **Submetacentric**: the submetacentric chromosomes are J or S shaped. In these, the centromere occurs near the centre or at medium portion of the chromosome and thus forming two unequal arms.




4. **Metacentric**: The metacentric chromosomes are V- shaped and in these chromosomes the centromere occurs in the centre and forming two equal arms. The amphibians have metacentric chromosomes.