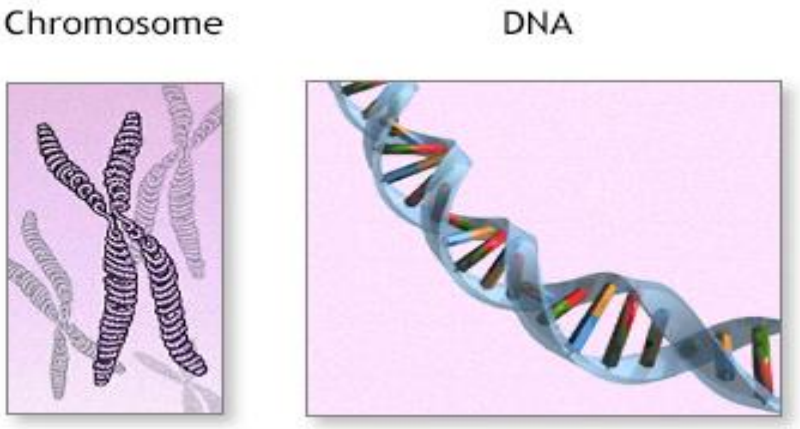
CHROMOSOMES

What is a Chromosome?

Chromosomes are thread-like structures located inside the nucleus of animal and plant cells. Each chromosome is made of **protein** and a **single molecule** of **deoxyribonucleic acid (DNA)**. Passed from parents to offspring, DNA contains the specific instructions that make each type of living creature unique.

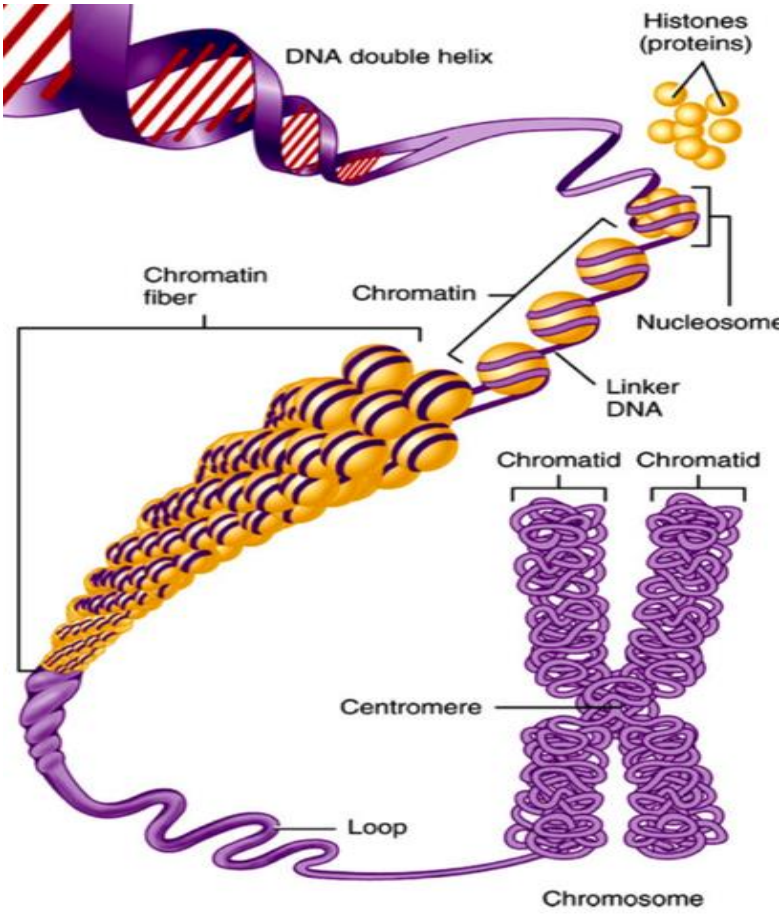
In eukaryotic cells, the nucleus divides before the cell itself divides. The term chromosome comes from the **Greek words** for color (**chroma**) and **body** (**soma**). Scientists named chromosomes because they are cell structures, or bodies, that are strongly stained by some colorful dyes used in research.



How many chromosomes do humans have?

Chromosomes come in pairs. Usually, each cell in the human body has 23 pairs of chromosomes (46 total chromosomes). Half of these come from the **mother,** and the other half from the **father**. Two of the chromosomes (the **X** and the **Y** chromosome) are called sex chromosomes, and in almost all people:

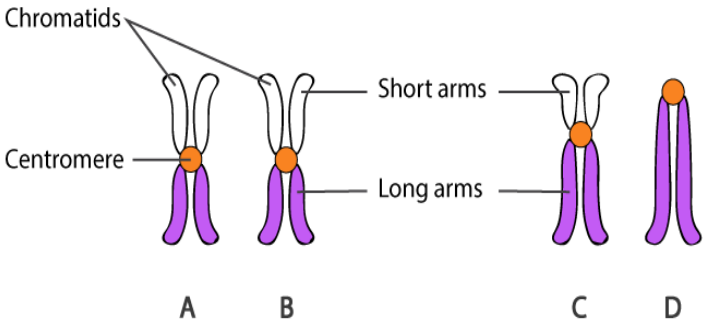
- **Females have 2 X chromosomes**.
- **Males have 1 X and 1 Y chromosome.**



What are centromeres?

A centromere is a constricted region of DNA or a structure in a chromosome that plays an essential role in the segregation of chromosomes during the cell cycle in eukaryotic cells. They link or hold together the pair of **sister chromatids**. The centromeres also separate the chromosome into a **short arm (p)** and a **long arm (q)**.

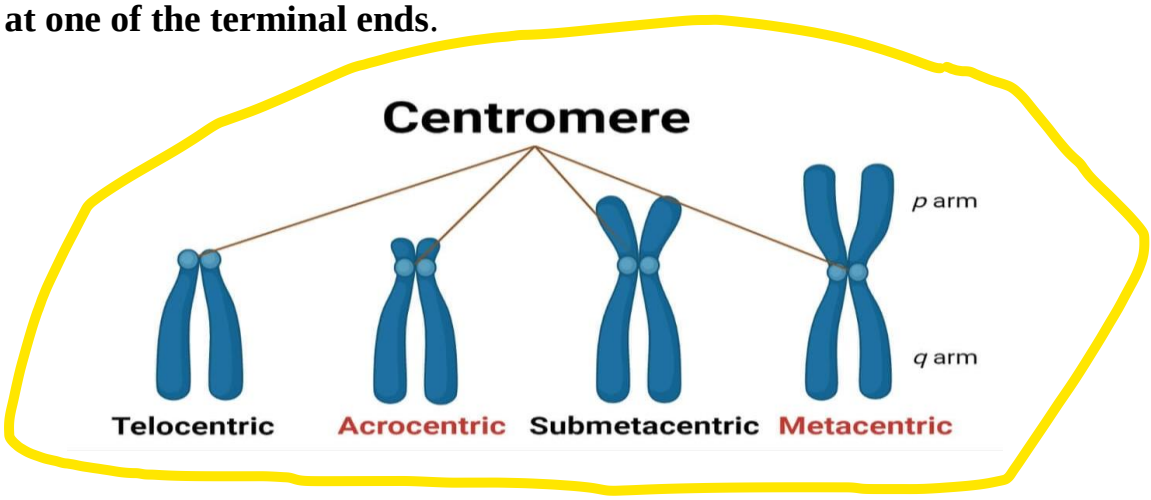
As the name suggests, centromeres are not located precisely **in the center** but at the end of chromosomes. This organelle, present on either side of the centromere, is also referred to as the chromosome's arms.



How does the centromere position form the basis of the classification of chromosomes?

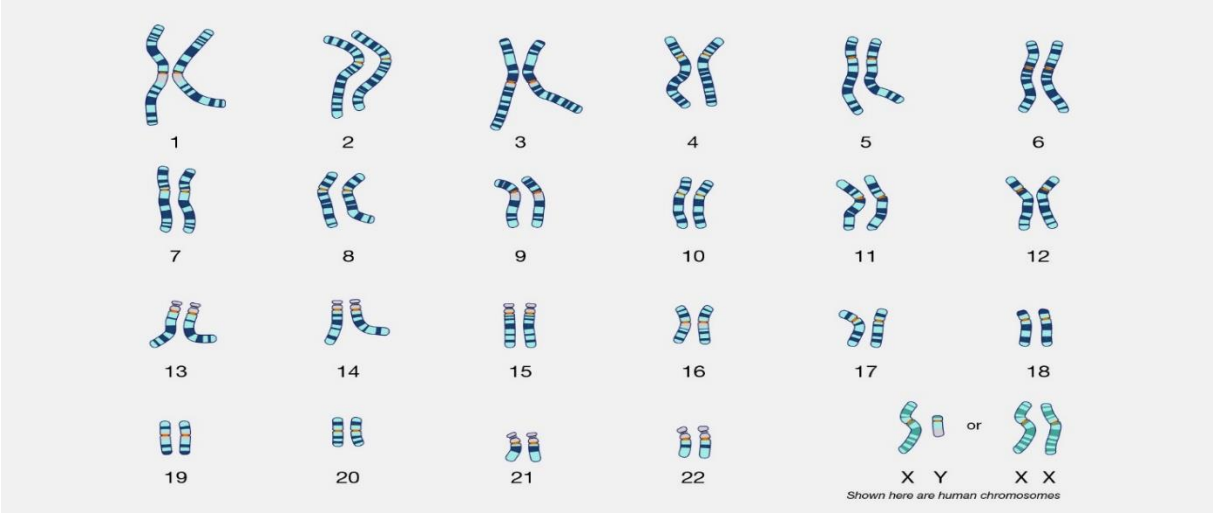
Chromosomes are divided into four types based on the position of the centromere.

1. **Metacentric chromosome:** The chromosomes in which the centromere is present in the **middle** divide the chromosome into two equal arms.
2. **Sub-metacentric chromosome:** The chromosome in which the centromere is **slightly away** from the middle region is a sub-metacentric chromosome. In this, one arm is slightly longer than the other.
3. **Acrocentric chromosome:** An acrocentric chromosome is one in which the centromere is located **close to one of the terminal ends**. One arm is extremely long, and the other is extremely short.
4. **Telocentric chromosome:** A telocentric chromosome is one in which the centromere is located **at one of the terminal ends**.



What is Karyotype?

A karyotype is a microscopic image of an individual's chromosomes. During **prometaphase** and **metaphase** of the **M phase**, chromosomes are condensed when it is easiest to visualize them under the microscope. The normal **male karyotype** is **46**, **XY**, and the normal **female karyotype** is **46**, **XX**, indicating the total number of chromosomes and the **sex chromosomes**. Chromosomes are different in size and shape.



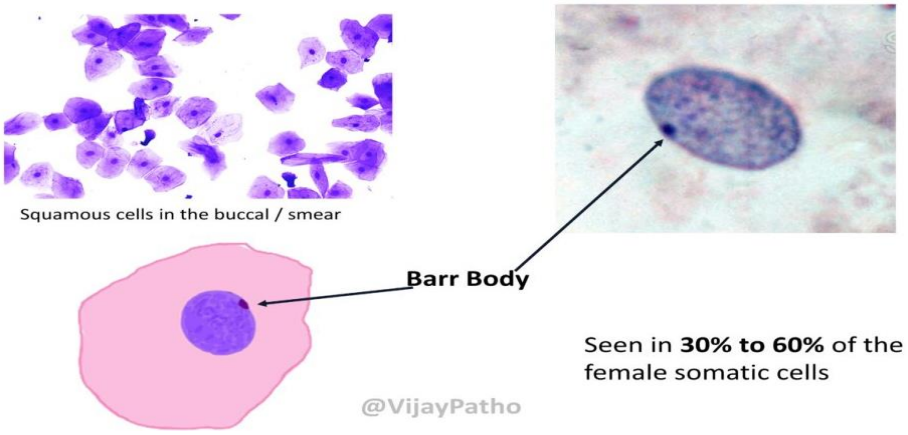
What is Sex chromatin or (BARR Body)?

A **Barr body** is a small, well-defined body that **darkly stains** intensely with nuclear dyes. In most cases, it is found in the **periphery of the nucleus**. It is present in a large proportion of nuclei of female origin and **absent** in male nuclei. The **Barr body**, sometimes called the **sex chromatin**, is the inactive X chromosome in female somatic cells. Human females have two X chromosomes, while males have one X and one Y.

A Barr body (named after discoverer **Murray Barr**)

Sex-chromatin = Inactivated X chromosome

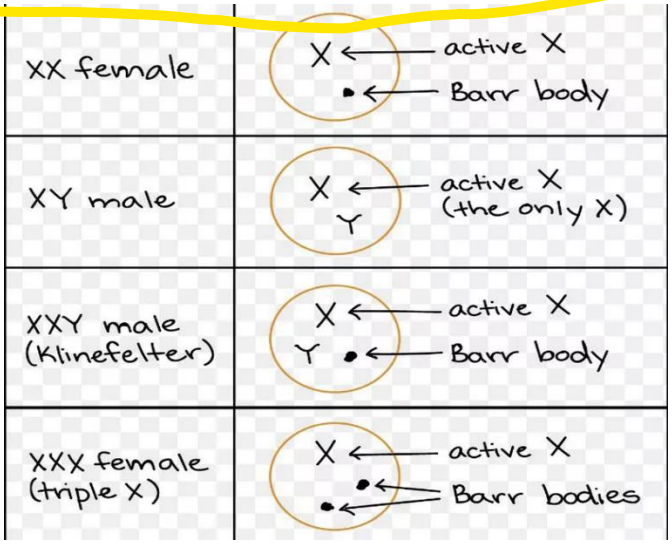
- Female XX - 1 Barr body
- Male XY - no Barr body



What do Turner's and Klinefelter's syndromes cause?

Turner's and **Klinefelter's** syndromes can be a genetic disorder in females/ males. It is caused not by heredity but by the **loss** or **extra** X and Y chromosomes. **Klinefelter's syndrome (KS)** affects one in 600 men, and **Turner's syndrome (TS)** affects one in 2500 women.

These two diseases are the most sex chromosome disorders characterized by one extra X in the **(KS)** male (**47XXY**) and the loss of an X in the girls with **(TS)** (**45 X**).



What do the Mitotic index

Mitotic index refers to the ratio **of cells** undergoing mitosis to the **total number of cells** counted, expressed as a percentage. It measures the rate of cell division and is often used as an indicator of the growth and proliferation of cells, particularly in **cancer research**. A high mitotic index indicates a more significant proportion of cells undergoing mitosis, which may indicate **abnormal cell growth** or **tumor development**.

Mitotic Index = (Number of cells in mitosis / Total number of cells) × 100