Chromosome

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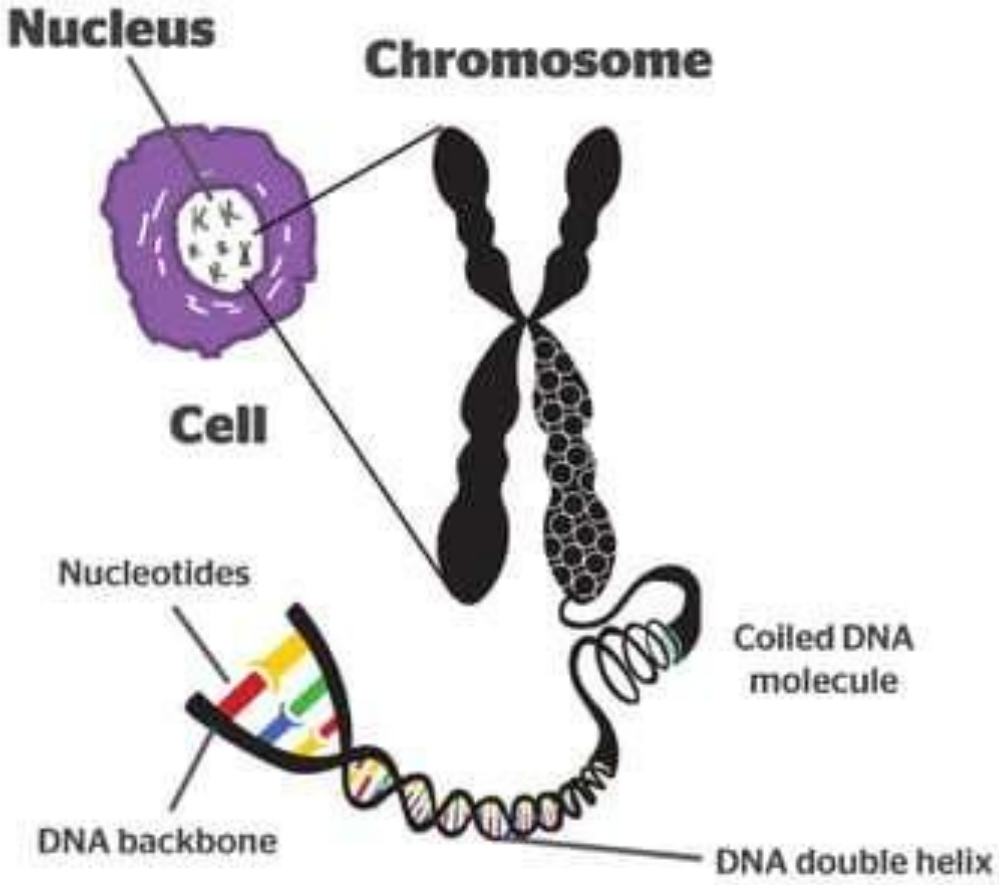
Outline

- Defination and history
- Features of eukaryotic chromosome
- Chromosome size, shape and number
- Chemical composition of chromosome
- Chromosome structure

Relative position of chromosome in cell



Introduction and History

- **Definition** – Chromosomes are the rod-shaped, dark-stained bodies seen during metaphase stage of mitosis.
- **Strausberger** discovered chromosome in 1875
- The term chromosome was coined by **Waldeyer** in 1888
- Term initiated as (Chroma= Colour and Soma = body)

Features of eukaryotic chromosome

- Chromosomes are best visible during metaphase
- Chromosomes bear genes in a linear fashion
- Chromosomes vary in shape, size and number in different species of plants and animals
- Chromosomes have property of self duplication and mutation
- Chromosomes are composed of DNA, RNA and protein

Chromosome size, shape and number

Chromosome size

- Chromosome size is measured at mitotic metaphase generally measured in length and diameter
- Plants usually have longer Chromosome than animals
- Plant Chromosomes are generally 0.8-7μm in length where as animal chromosomes are 0.5-4μm in length
- Chromosomes size varies from species to species

Chromosome shape

- The shape of chromosome is generally determined by the position of centromere

- Chromosomes generally exits in three different shapes, *viz., rod shape, J shape and V shape*

Chromosome number

- Each species has definite and constant somatic and genetic chromosome number
- Somatic chromosome number is the number of chromosome found in somatic cells while genetic chromosome number is the number of chromosome found in gametic cells.
- Somatic chromosome are always diploid and are denoted as 2n where as genetic chromosomes are always haploid and are denoted as n
- In human being somatic chromosomes are XX and XY where as genetic chromosome number is X and Y

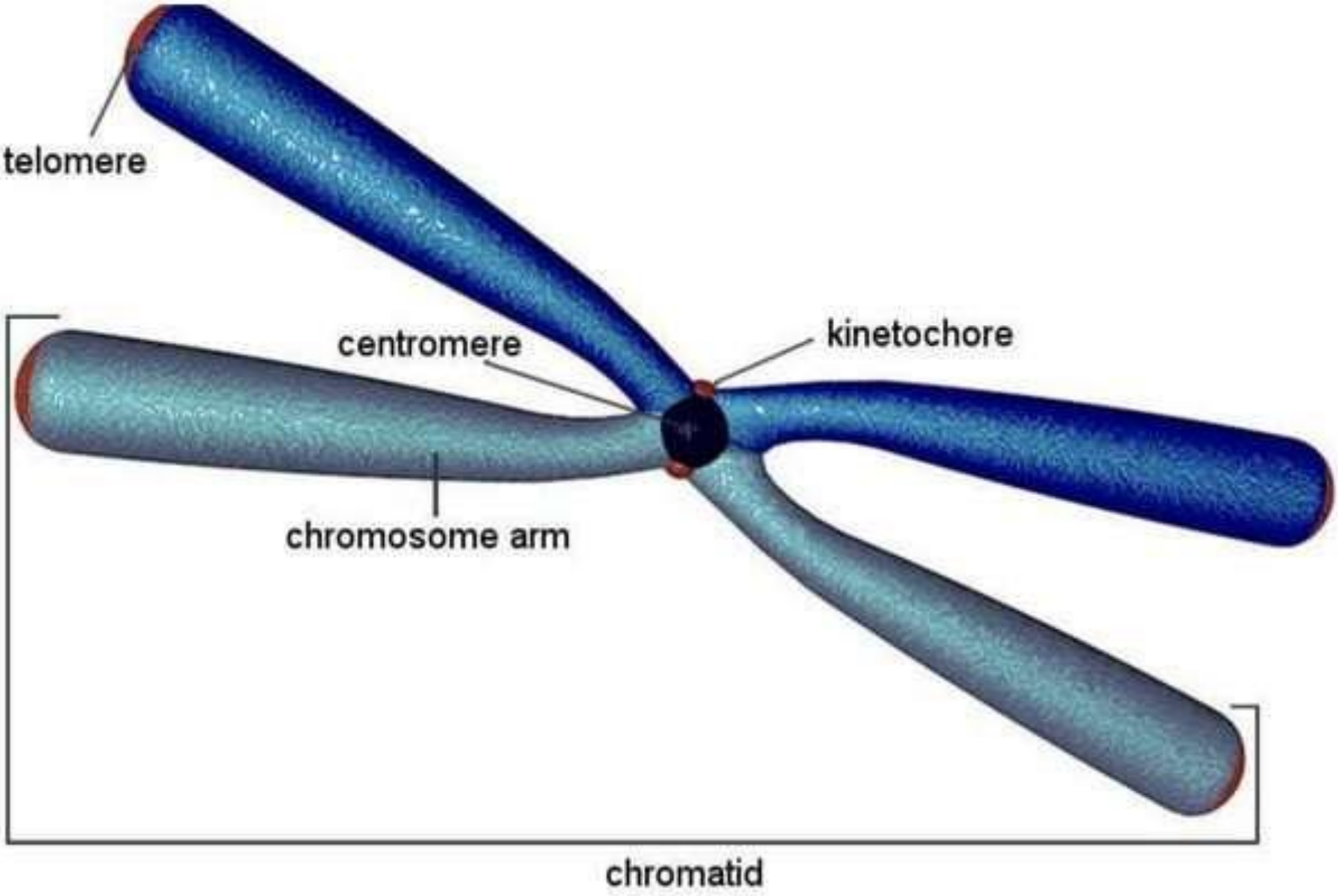
Somatic chromosome number of some common plants and animals

Sr. no	Scientific name	Common name	Chromosome number	
			Somatic	Gametic
1	*Homo sapiens*	Human	46	23
2	*Oryza sativa*	Rice	24	12
3	*Rattus norvegicus*	rat	42	21
4	*Pisum sativum*	Pea	14	7
5	*Daucus carota*	Carrot	20	10
6	*Allium cepa*	Onion	16	8
7	*Zea mays*	Maize	20	10
8	*Apis mellifera*	Honey bee	32	16
9	*Musca domestica*	House fly	12	6
10	*Felis domesticum*	Cat	38	19
11	*Drosophila melanogaster*	Fruit fly	8	4
12	*Neurospora Crassa*	Bread mold	14	7

Chromosome structure

- **Structurally chromosomes consists of seven parts**

1. Centromere
2. Chromatid
3. Secondary constriction and satellite
4. Telomere
5. Chromomere
6. Chromonema
7. Matrix


telomere
centromere
kinetochore
chromosome arm
chromatid

1. **Centromere-** It is a localized region of the chromosome with which spindle fibers attached is known as centromere or primary constriction or kinetochore

2. **Chromatid-** One of the two distinct longitudinal subunits of a chromosome is called as chromatid. Chromatids are of two types sister chromatids and non-sister chromatids.

3. **Secondary constriction-** Some chromosome exhibits secondary constriction in addition to primary constriction. The chromosomal region between telomere is called as **satellite** or **trapant.** *The chromosome having satellite is called as satellite chromosome.*

4. **Telomere-** The two ends of chromosome are called as telomeres. Telomere are highly stable and they do not fuse or unite with telomere of other chromosome.

5. **Chromomere-** The chromosomes of some of the species shows small bead like structures called as chromomeres. The structure of chromomeres in chromosome is constant.

6. Chromonema- Thread like coiled structures found in the chromosomes and chromatids are known as chromonema (plural chromonemata).

7. Matrix – It is a fluid part in which chromonemata are embedded is called as matrix. Matrix is

Chemical composition of chromosome

- Chemically chromosomes are nucleoprotein in nature means are composed of RNA, DNA and protein.

- Generally chromosomes contains 30-40% DNA, 50-65% protein and 0.5-10% RNA

1) **DNA**- The amount of DNA present in somatic cell is constant. DNA content of gametic cell is half of that of somatic cell.

   DNA of chromosome is of two types *i) Unique DNA ii) Repetitive DNA*

i) Unique DNA- unique DNA consists of those DNA sequence which are present in a single copy per genome and are unique in nature

- Unique DNA is also known as non repetitive DNA. Codes for protein which requires in large quantity for cell. eg- storage protein

ii) **Repetitive DNA-** Repetitive DNA consists of DNA nucleotides or base sequences, which are few to several hundred base pairs (bp) long and are present to several to a million copies per genome. Human genome contains 30% repetitive DNA. Repetitive DNA is further divided into

i) Highly repetitive DNA and

ii) Moderately repetitive DNA

2) RNA- Purified chromatin contain 10-15% RNA. RNA associated with chromosome is messenger RNA, transfer RNA and ribosomal RNA.

3) Protein- Protein associated with chromosome is classified into two broad groups

i) Histone or basic protein

ii) Non histone protein

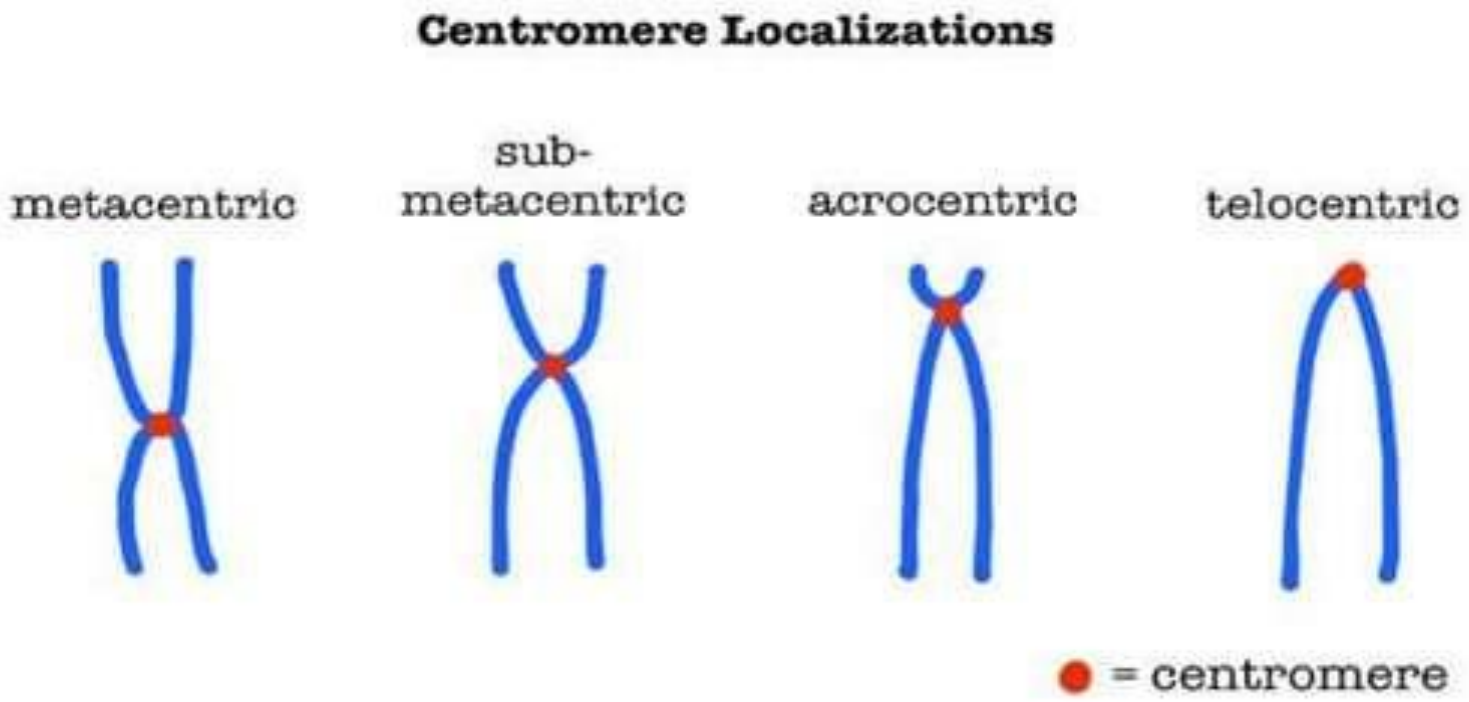
Non histone proteins are acidic in nature and histone proteins are basic in nature because of basic amino acids.

i) Histone protein- histones constitutes about 80% of the total chromosomal protein. They are present in an almost 1:1 ratio with DNA. Five fractions of histones are present like $1H_1$, $2H_2a$, $2H_2b$, $2H_3$ and $2H_4$

ii) Non histone protein- non histone proteins make up to 20% of the total protein mass. Content of non histone protein is different from species to species. Non histone protein includes many important enzymes like DNA and RNA polymerase.

Types of chromosome

- According to the relative position of centromere chromosomes are divided into four types



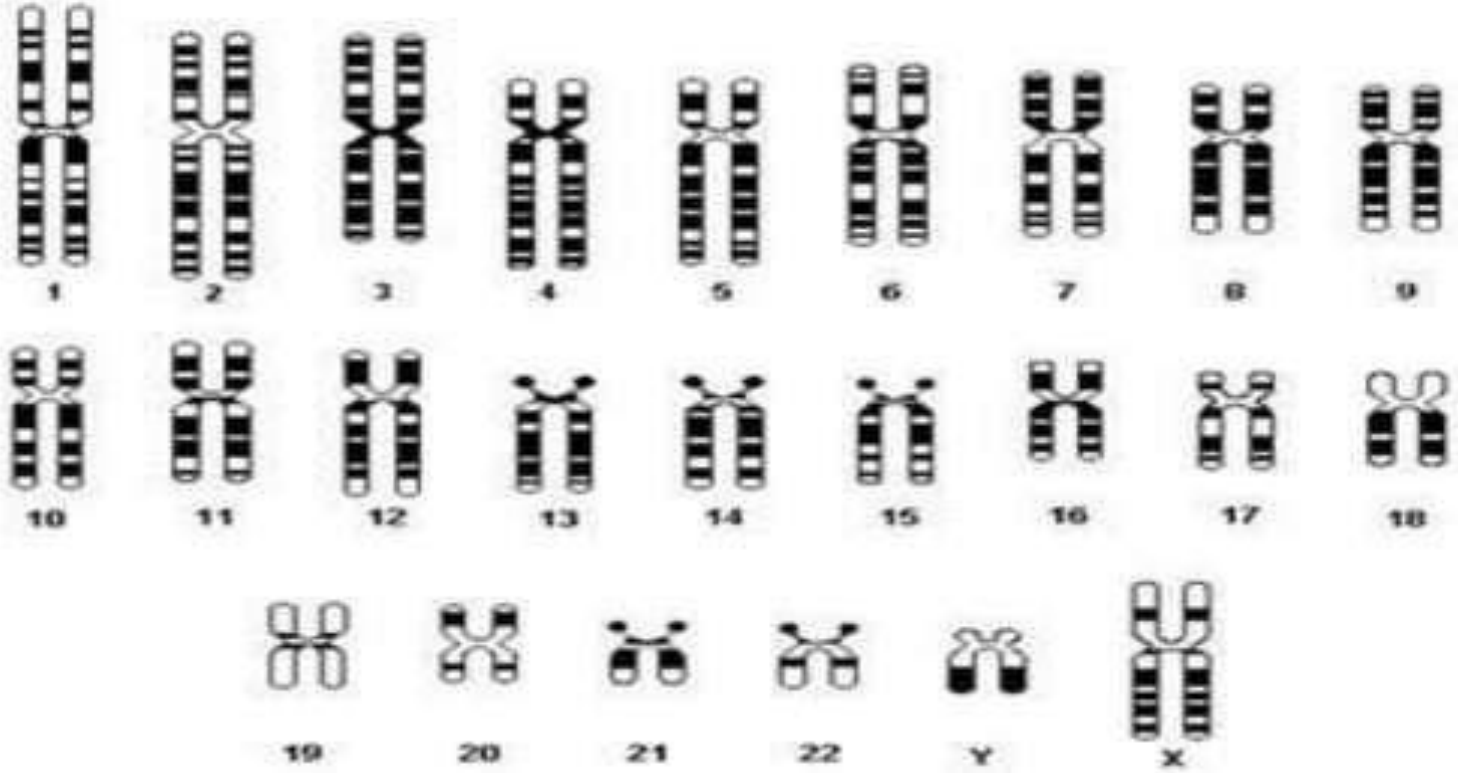
Karyotype

- Complete set of chromosomes in a species, or in an individual organism is known as karyotype.

- The basic number of chromosomes in the somatic cells of an individual or a species is called the *somatic number* and is designated *2n*. Thus, in humans 2n = 46

Idiogram

- A diagrammatic representation of chromosome morphology characteristic of a species or a population is known as Idiogram



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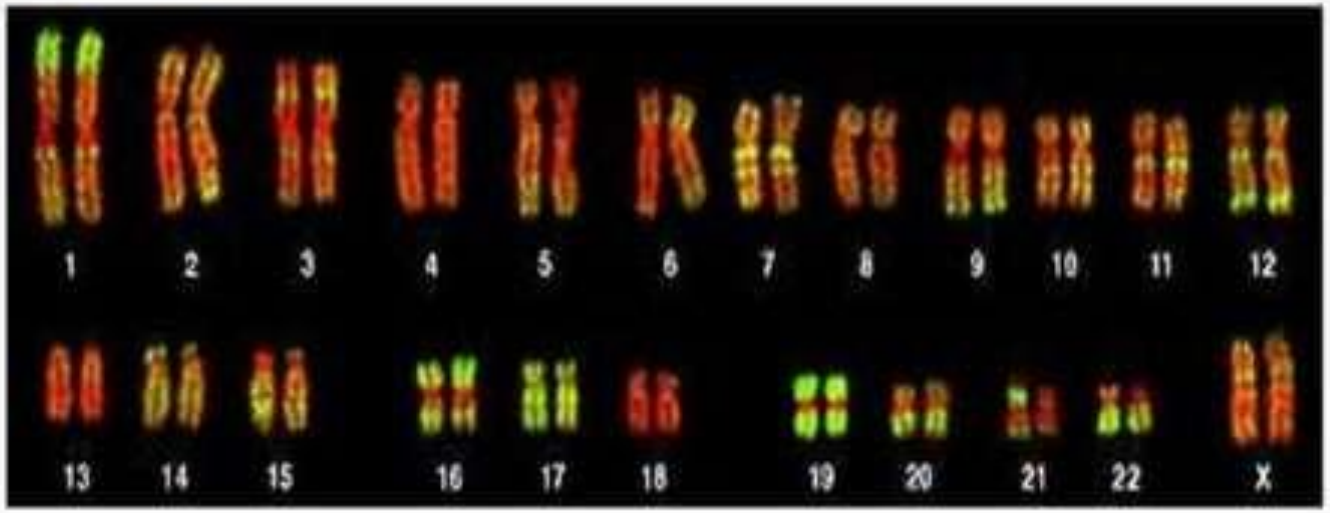
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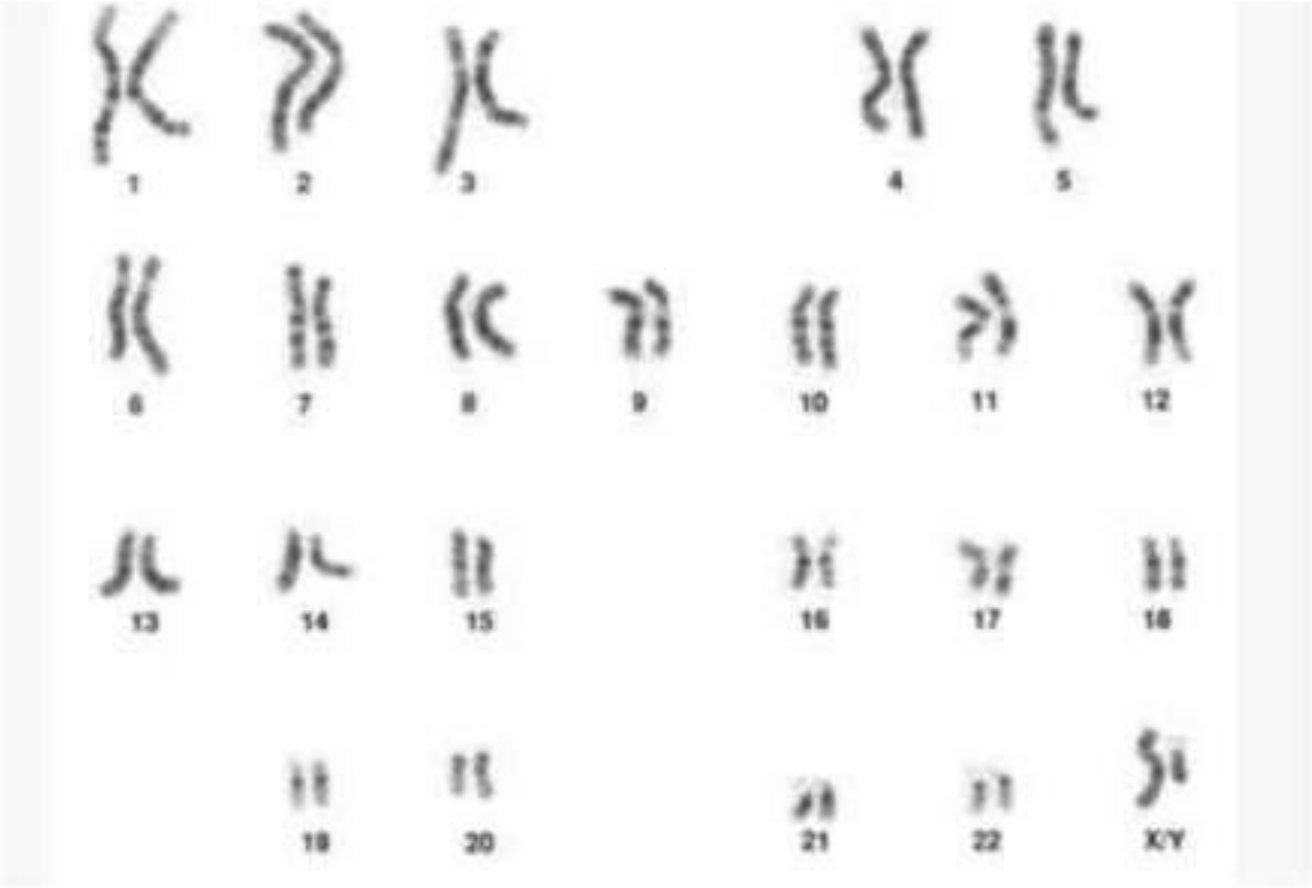
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X/Y

Reference Book

Genetics

By

B. D. Singh

(Kalyani Publications)