Biology Grade 9

CHAPTER 7: CHROMOSOMES, CARRIERS OF GENETIC INFORMATION

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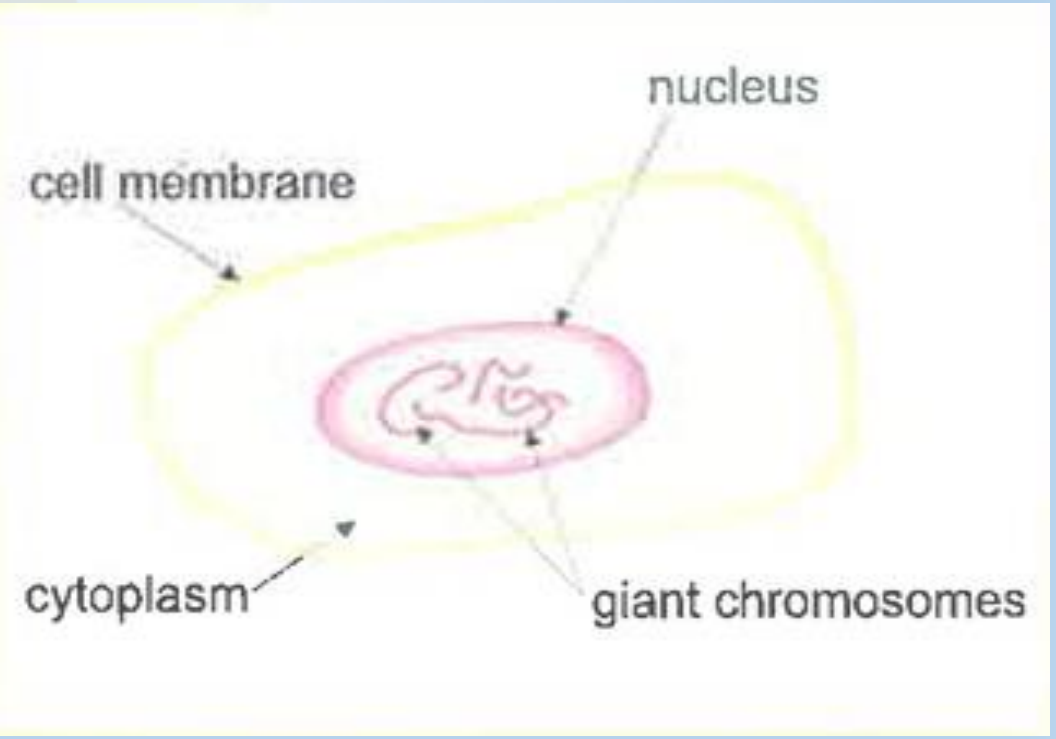
Activity 3: The carriers of genetic information

- The transmission of hereditary traits from parents to offspring implies the existence of a certain information, a real genetic program that passes from one generation to another and called for this reason the genetic information.
- Chromosomes present in the cells are the carriers of this genetic information.
- What is a chromosome?
- Where are chromosomes localized in the cell?
- What does the observation of human chromosomes provide with?

Be Smart ACADEMY

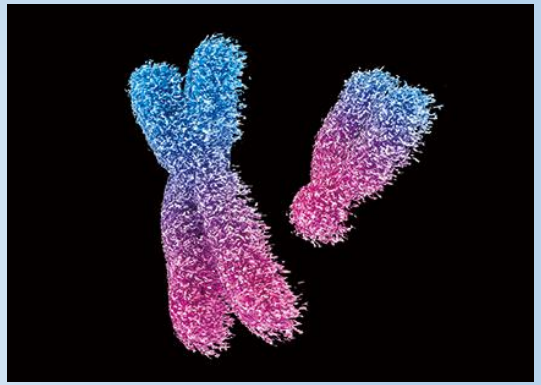
❖ Localization of Chromosomes,

- In the nucleus of all cells, there are filaments. These are the chromosomes, only visible when the cell is dividing.
- In certain insects (Chironomid), the chromosomes, very big in size (giant), are permanently visible in the nucleus of the cells of the salivary glands of their larva.



❖ Important terms

- **Heredity:** study the transmission of traits from the parents to their offspring. (From one generation to another).
- **Genetic program:** all the genetic information carried by chromosomes.
- **Hereditary trait:** a trait that is transmitted from the parents to the offspring. Ex: color of the eyes, color of the hair, blood type, some diseases …

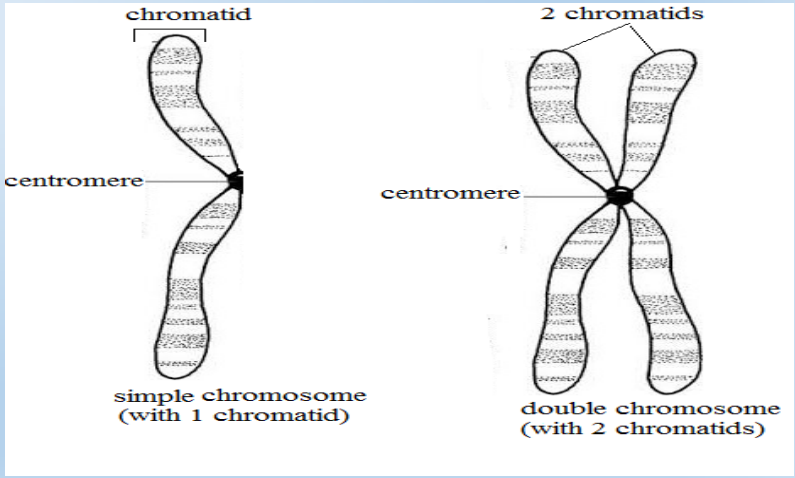


- **Chromosomes:** filament-like structures, found in the nucleus of the cell (plant and animal cells).

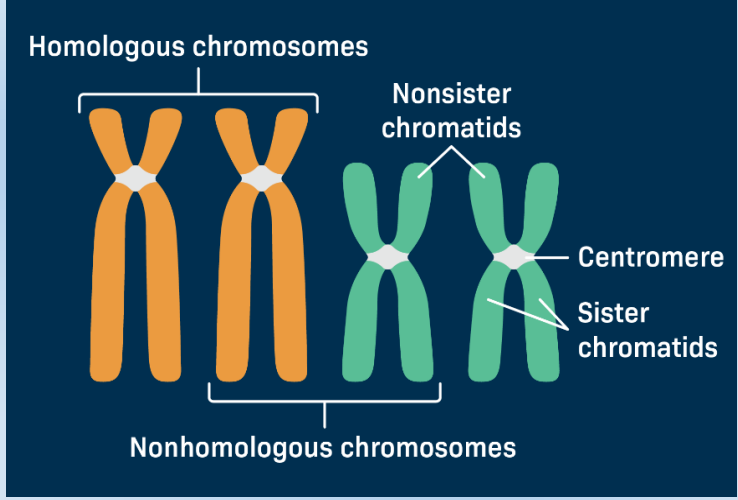
✓ They carry the genetic information.

✓ They are only visible during cell division.

✓ A chromosome is formed of 2 identical units called chromatids, joined together with the centromere.



- **Homologous chromosomes** (similar chromosomes): chromosomes that are similar in size, position of centromere, bands, and carry information for the same traits (in the same location).



❖ **How Chromosomes Are Observed and Analyzed:**

- Inside the nucleus of cells, chromosomes are normally spread out (dispersed) and cannot be seen clearly. They become visible only during **cell division**.
- To observe them, scientists follow these steps:
- **Stain the chromosomes** to make them visible.
- **Burst the cell** (a process called cell lysis) to release the chromosomes.
- **Capture an image** of the chromosomes under a microscope.
- Next, the chromosomes are:

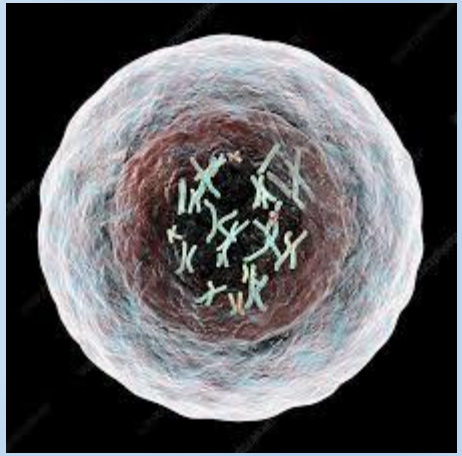
➢ **Counted**

➢ **Cut out from the image**

➢ **Classified** based on size and shape

➢ **Numbered**

- This organized image is called a **karyotype**, which shows all the chromosomes of an individual.



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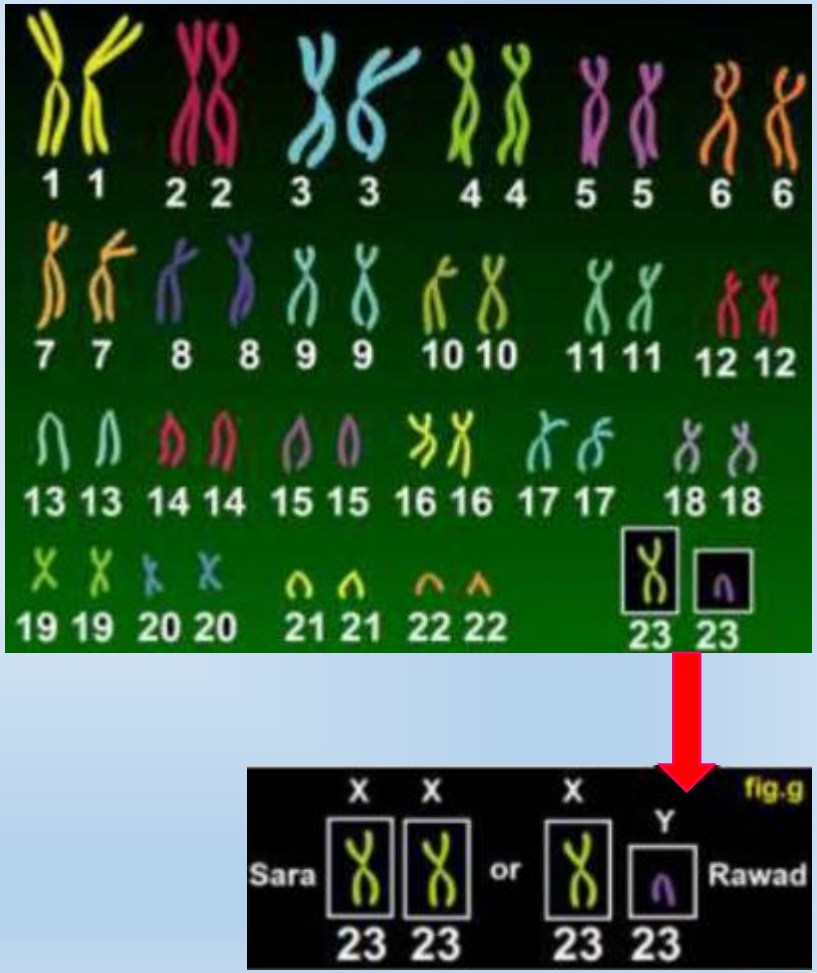
❖ Definition of Karyotype:

- A **karyotype** is the **complete set of chromosomes** in a cell, **organized and displayed** in pairs according to their **size, shape, and number**.
- It is used to **study the chromosomes** of an individual, to **identify genetic abnormalities** and to Determine if a person is **male (XY)** or **female (XX).**



❖ What are the criteria used to create a karyotype?

The criteria used to create a karyotype:

- ✓ Arrangement of chromosomes in **pairs of homologous chromosomes**
- ✓ Ordered in **decreasing size** (from largest to smallest)
- ✓ Based on the **position of the centromere**
- ✓ According to the **banding pattern**.

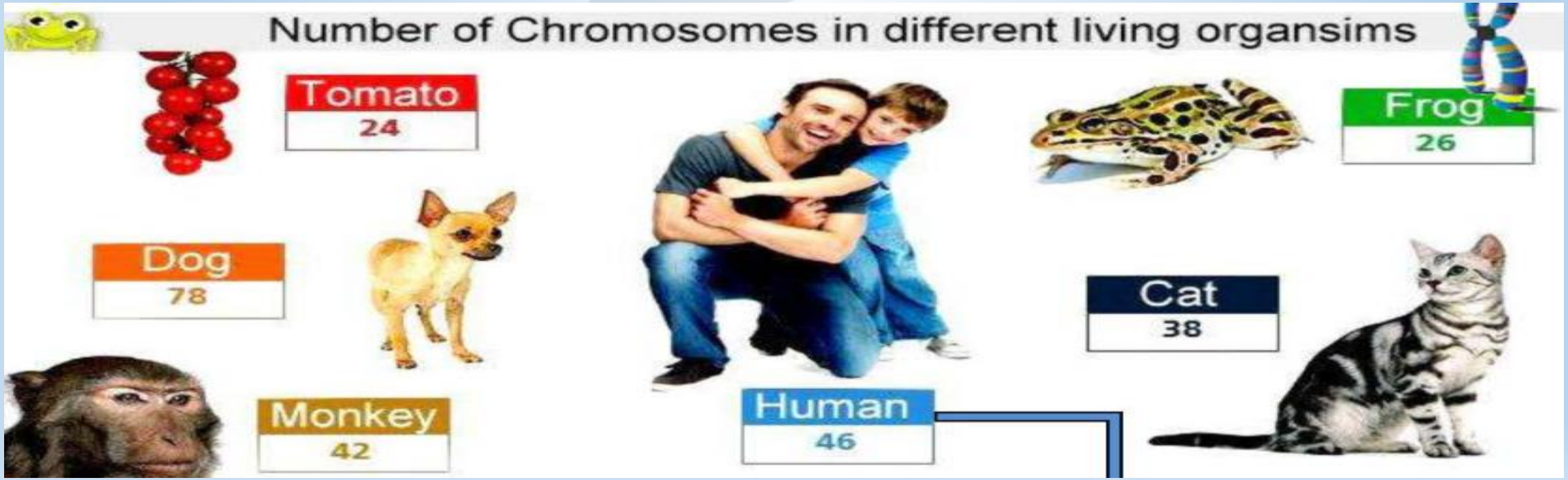
The number of chromosomes is constant for all the individuals of the same species; also, it is constant in all the cells of the individual.

Ex: In human: 2n = 46 chromosomes (23 pairs)

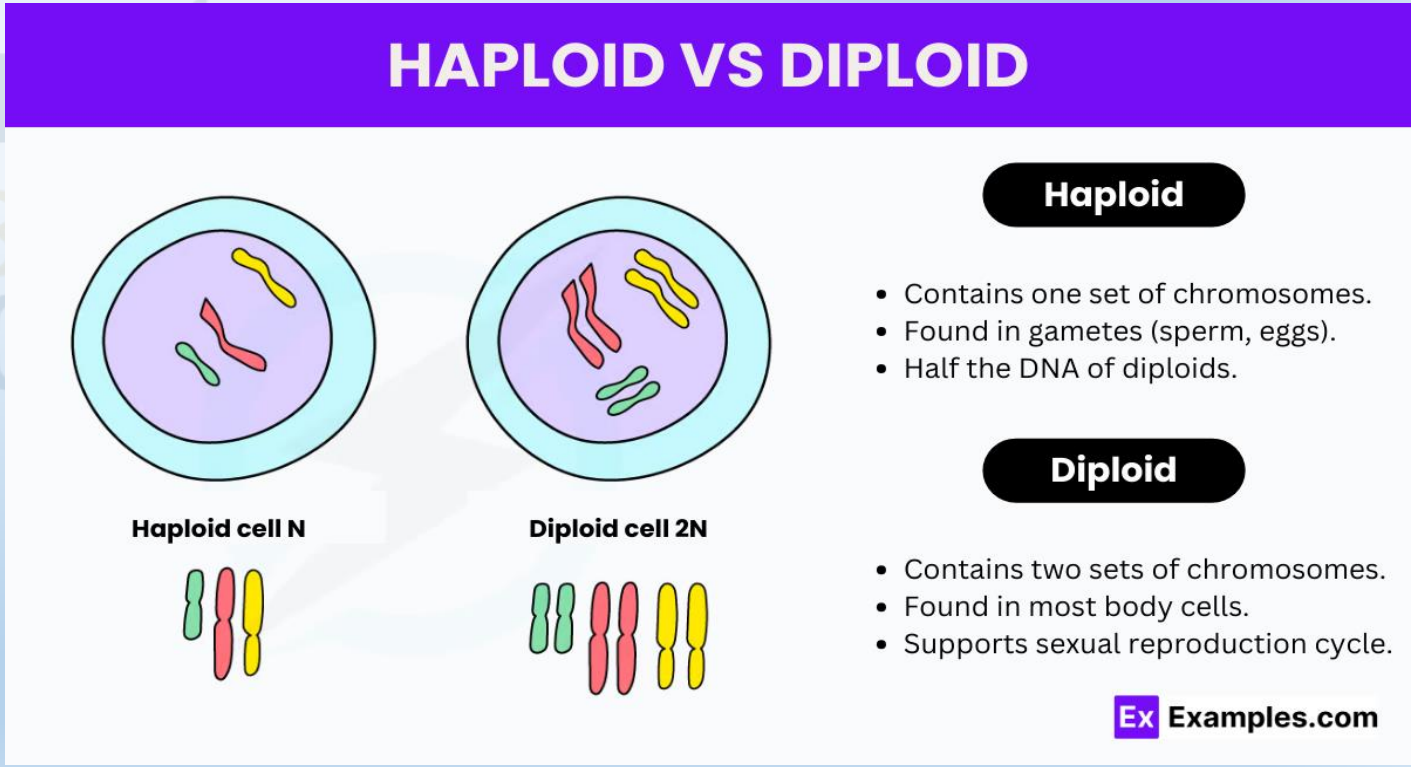
In cat: 2n = 38 chromosomes (19 pairs)

In pea: 2n = 4 chromosomes (2 pairs)

- **The chromosomal formula of a species is represented by (2n), where (n) stands for a set of different chromosomes of paternal origin and the other (n) for a set of chromosomes of maternal origin.**



- Each individual receives a set of chromosomes **(n) of paternal origin (from father)** and another set of chromosomes **(n) of maternal origin (from mother); n in humans is equal to 23.**
- Thus, all the cells of the body (somatic cells) contain **2 copies of each chromosome (2n)** [(n) from the mother and (n)from the father]; they are called **diploid cells.**
  Ex: white blood cell, muscle cell, skin cell, nervous cell..
- Except for the gametes (spermatozoa and ova), they contain **only 1 copy of each chromosome (n)**; they are called **haploid cells.** (n = 23 chromosomes).



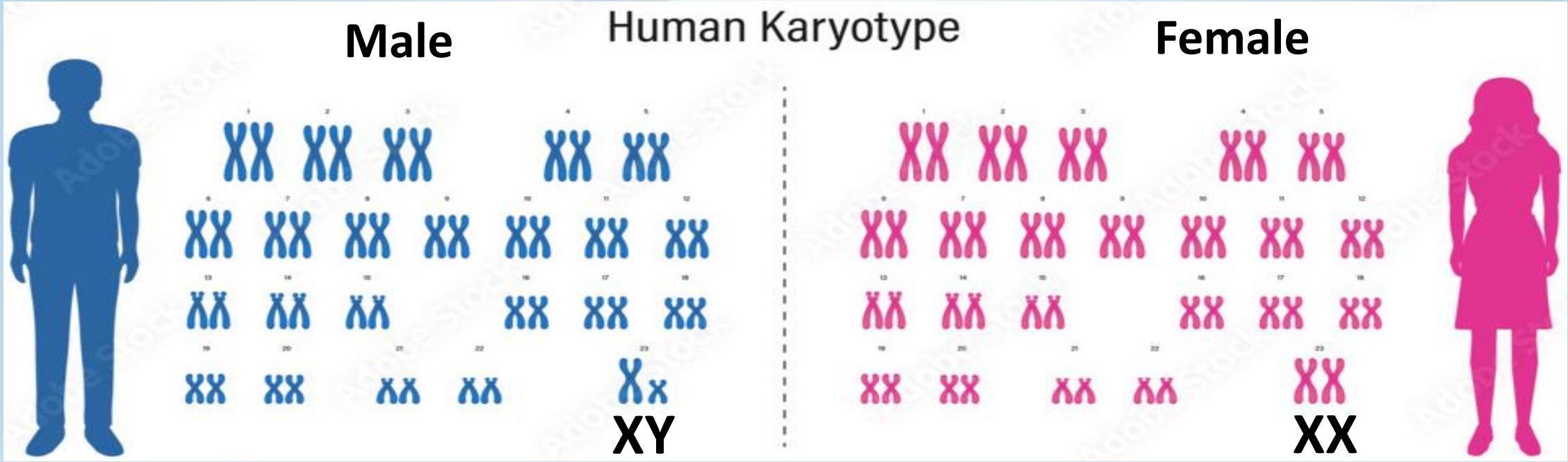
❖ Human Karyotype:

The number of chromosomes is **2n = 46 chromosomes (23 pairs);**

- **44 Autosomes (22 pairs),** numbered from 1 to 22; they are **common between male and female.**
- **2 Gonosomes (sex chromosomes); they determine the sex of the individual**; they are symbolized by letters X and Y.

➢ **The female has 2 similar sex chromosomes, XX.**

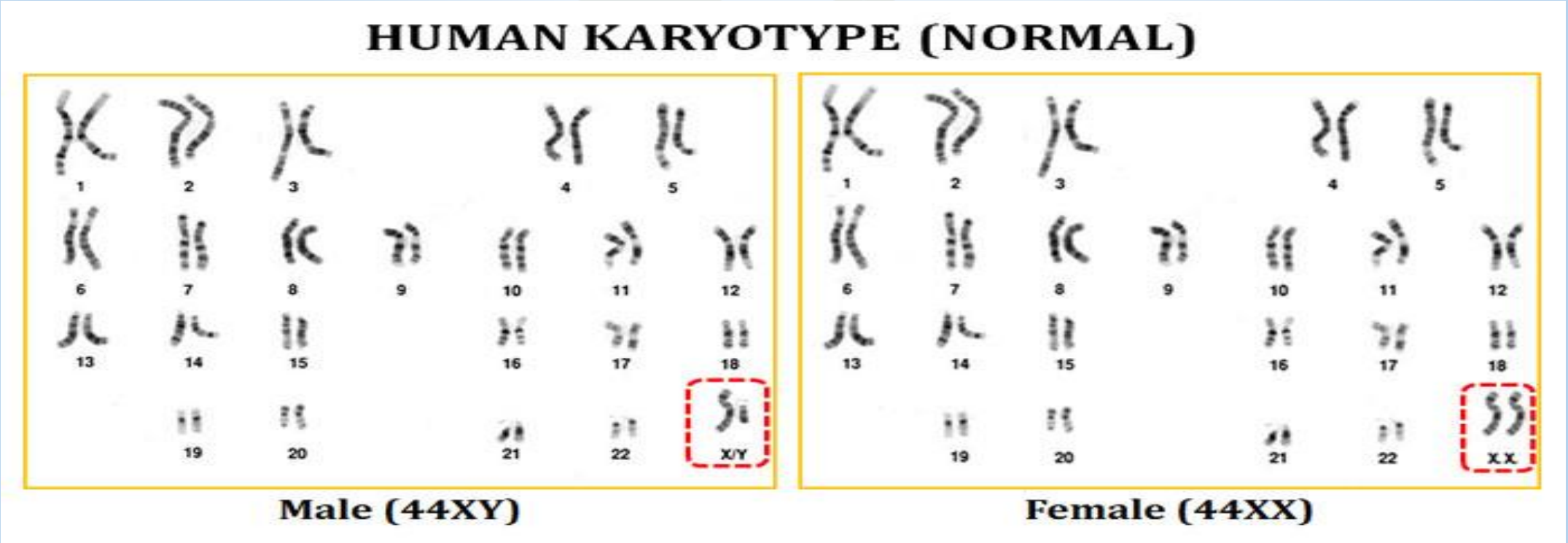
➢ **The male has 2 different sex chromosomes, XY (Y determines the masculine sex).**



❖ Chromosomal formula:

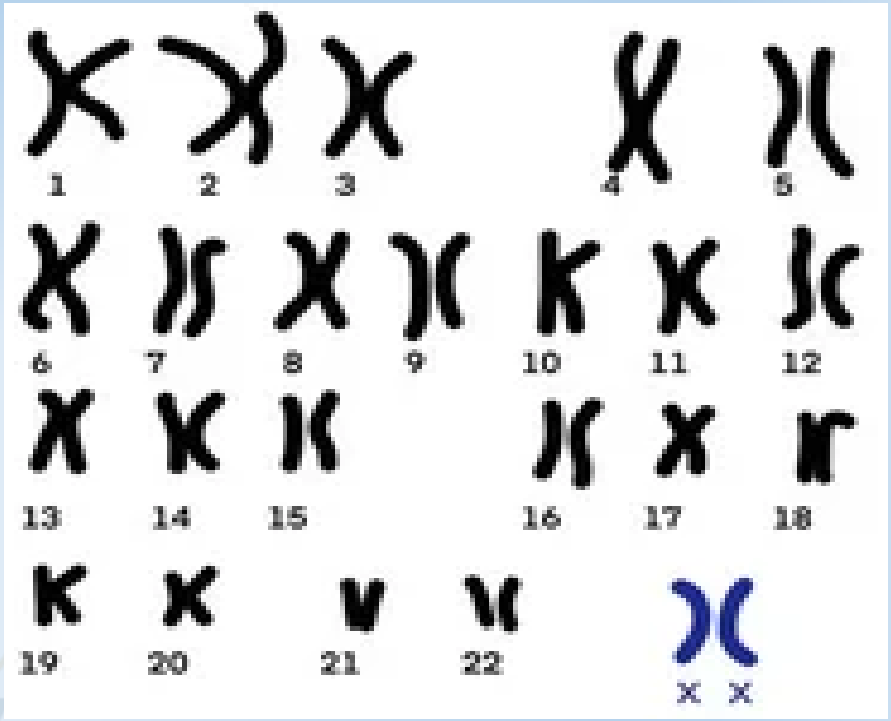
- The chromosomal formula is represented by "**the number of chromosomes**," "**the sex chromosomes**," and "**abnormality**."
- Ex: - Chromosomal formula for human male: **46, XY** (or 44+XY).

  - Chromosomal formula for human female: **46, XX** (or 44+XX).



A study was done on the human chromosomes, the following figure is obtained:

1. Name the chrs numbered from 1 to 22. **Autosomal.**
2. Count them? How many pair? **44 chr, 22 pairs.**
3. Are these pairs homologous or not? **Homologous.**
4. Name the last chr pair. **Gonosomes / sex chr.**
5. Count them. How many pairs? **2chr, 1 pair.**
6. Is pair 23 homologous or not?. **Homologous.**
7. Conclude the sex of this individual. **Female.**
8. Give a title for this figure. **Female Human karyotype**
9. Indicate the chromosomal formula of this cell. **46,XX**



10 Referring to your knowledge, indicate the nature of pair 23 found on the other sex. **XY**

11. List two criteria used to obtain such a karyotype.

Decreasing order of size

Arrangement of chromosomes in pairs of homologous chromosomes

Summary

Cell	Body cell: skin/muscle... (Somatic cells)	Sperm/ova (Gametes)
Type (nature)	Somatic cell	Gamete cell
Number of chr	46	23
Chr formula	46,XX or 46,XY	23,X or 23, Y
Haploid or Diploid	Diploid	Haploid
n or 2n	2n	n