Biology Course	Chapter 7 – Chromosomes, Carriers of Genetic Information	Class: Gr. 9

A- Sexual and Asexual Reproduction:

- **Asexual Reproduction:**

  It is a reproduction that does not require the intervention of male and female **gametes** (sexual cells).

  Ex: Formation of a potato plant (bearing tubers) from a single tuber.

- **Sexual Reproduction:** it is the reproduction that requires the intervention of male and female gametes (reproductive cells) and their fertilization.

In animals and humans:

	Reproductive Organs	Reproductive Cells or Gametes
Male	Testicles	Sperm cells
Female	Ovaries	Ovules

In plants:

	Reproductive Organs	Reproductive Cells or Gametes
Male	Stamens	Pollen grains
Female	Pistil	Ovules

- The union of a male and female gamete forms an egg cell called a **zygote**.

B- Definitions :

- **Genetics**: The science of heredity.
- **Heredity**: The transmission of the hereditary characters from the parents to the descendants (offsprings).
- **Hereditary characters**: The characters that are transmitted from one generation to another.
- **Non-hereditary characters**: The characters that are not transmitted from one generation to another. They may undergo changes due to living conditions.

Activity 1:

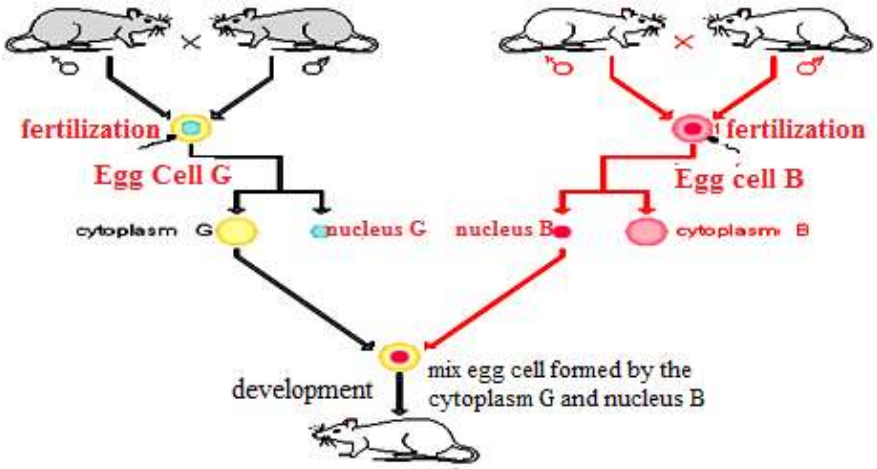
C- What are a nucleated cell and a non-nucleated (enucleated) cell?

The living being is made up of small units called **cells**:

- Among the cells of our body, some cells have a dark structure inside them, called nucleus. These cells are called nucleated cells (Ex: White Blood Cells).
- Other cells, do not contain a nucleus, are called non-nucleated or enucleated cells (Ex: Red Blood Cells).
- The **nucleus** of a cell contains all the genetic information responsible for the character of the individual. (Experiment p. 120 / doc. a)

Application:

1. **Describe/analyze** the following experiment:



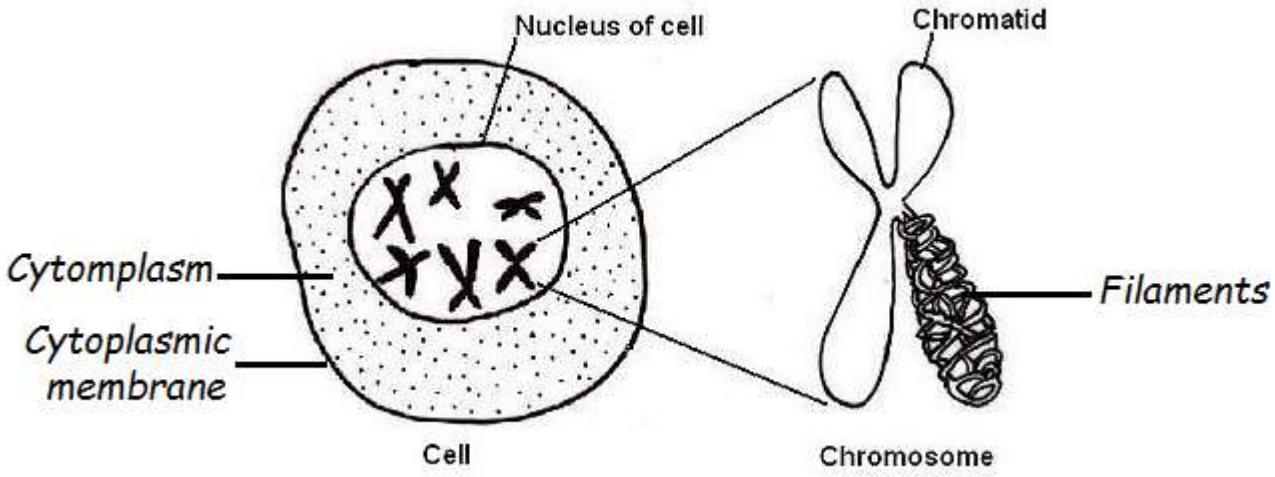
Application p. 3:

The fertilization of 2 grey mice gives an egg cell G and that of 2 white mice gives an egg cell B. The fusion between the cytoplasm G and the nucleus B gives a mix egg cell. The development of this egg cell gives a white mouse.

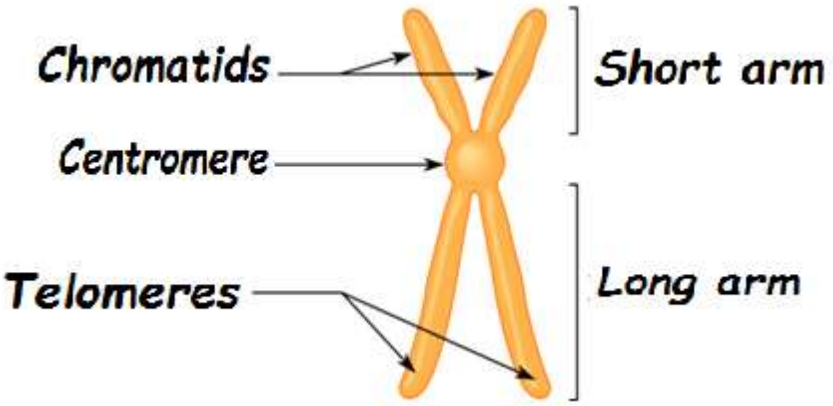
Draw out a conclusion: We can conclude that the genetic information is found in the nucleus.

D- Chromosomes and Genes:

- Chromosomes: filamentous bodies located in the nucleus of the cell and carrying the entire genetic program.



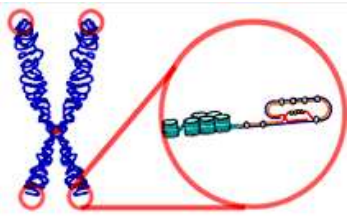
- **The chromosome** is made of DNA coiled in chromatids with a centromere.



Structure and representation of a chromosome

<u>Remarks</u>:

- The two chromatids of a chromosome are identical, so they are called sister chromatids.
- A telomere is a region of DNA at the end (extremities) of a chromosome:

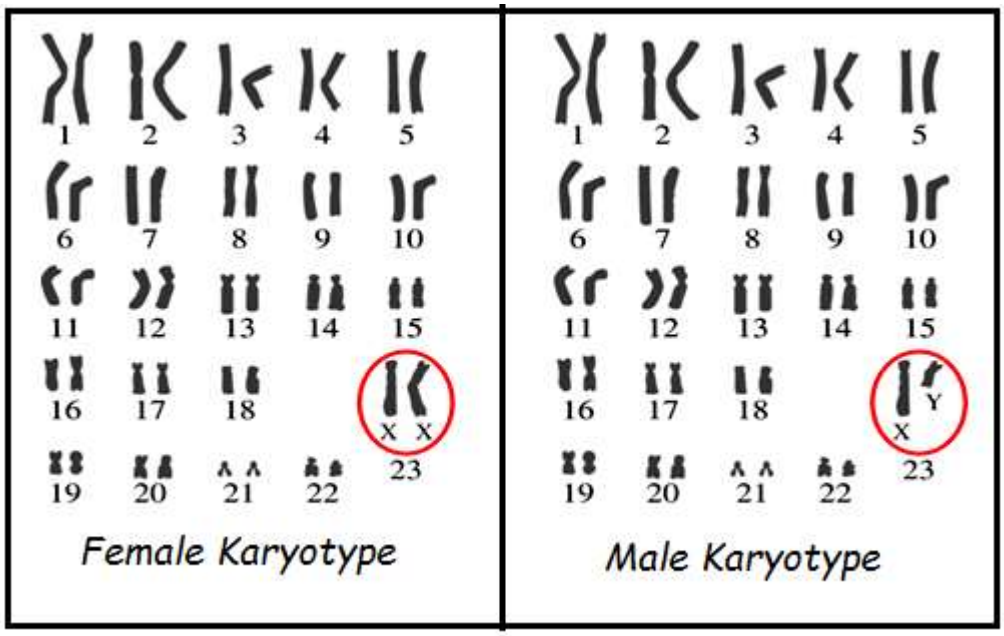


Activity 2:

E- Human Karyotype:

What is the number of chromosomes in human cells?

- **Karyotype:** it is the representation of all the chromosomes according to their size and the position of the centromere.
- **Human beings have:**
  - 46 chromosomes (23 pairs of chromosomes) in each cell of the body (non-sexual / somatic cells).
  - 23 chromosomes in the gametes (sexual cells: ovum or spermatozoon).



- The cell that has 46 chromosomes is a **diploid** cell (**2n**) because it has 2 copies of each type of chromosome.

  The cell that has 23 chromosomes is a**haploid**cell (**n**) because it contains 1 copy of each type of chromosome.
- Two chromosomes are **homologous** if they have the same structure, the same shape and carry the same genes.
- Thus, each human cell contains 23 different types of chromosomes:

- 22 types of these nonsexual chromosomes are called **autosomes** and are numbered from 1 to 22.
- 1 type of sexual chromosome is called **gonosome** because it determines the sex of the individual and is designated by **X** or **Y**. The X-gonosome is found in male and female cells while the Y-gonosome is only found in male cells.

- The karyotype of a woman is: 22 pairs of autosomes + XX. (2n = 44 + XX); so the woman can produce 1 single type of egg (ovule): (22 autosomes + X)
- The karyotype of a male is: 22 pairs of autosomes + XY. (2n = 44 + XY); then the male can produce 2 types of spermatozoa in equal amounts: (22 autosomes + X) and (22 autosomes + Y).
- The Y-gonosome has a smaller size than the X-gonosome.

- The chromosomal formula: is the total number of autosomes + type of gonosomes.

- **<u>Application</u>: Complete the following table:**

Cellules	**Autosomes**	**Gonosomes**	**Diploidor haploid**	**Male or female**	**Chromosomal Formula**
Skin cells	44	XY			2n = 44 + XY
Sexual cells	22	Y			n = 22 + Y
Muscular cells	22 pairs	XX			
Spermatozoa	22	X			n = 22 + X
Ovule	22	X			

- **The importance of the karyotype:**

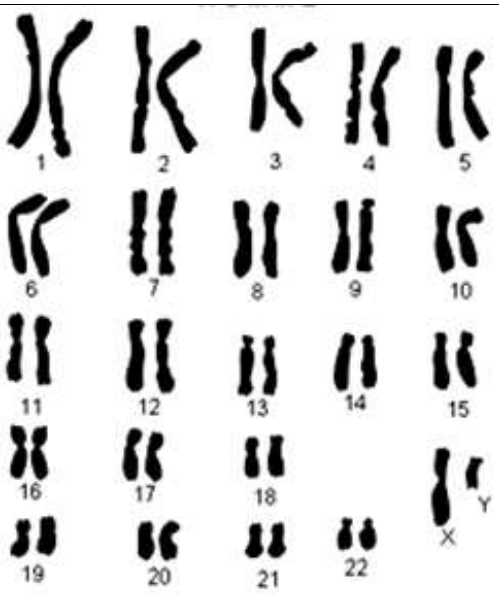
  A karyotype allows us to visualize the chromosomes, as well as to determine:
  - the total number of chromosomes
  - the number of autosomes and gonosomes
  - types of sex chromosomes

  Thus, it makes it possible to understand any anomaly (abnormality) concerning the number or the shape of the chromosomes.

- **The critera of the classification of chr.:**

  The chromosomes are classified in the karyotype,:
  1. according to the position of the centromere
  2. by homologous pairs of chromosomes
  3. by decreasing order of chromosome's size

Application:



1- Deduce the sex of the individual from whom this cell was taken.

_____

_____

_____

_____

2- Specify whether the cell is diploid or haploid.

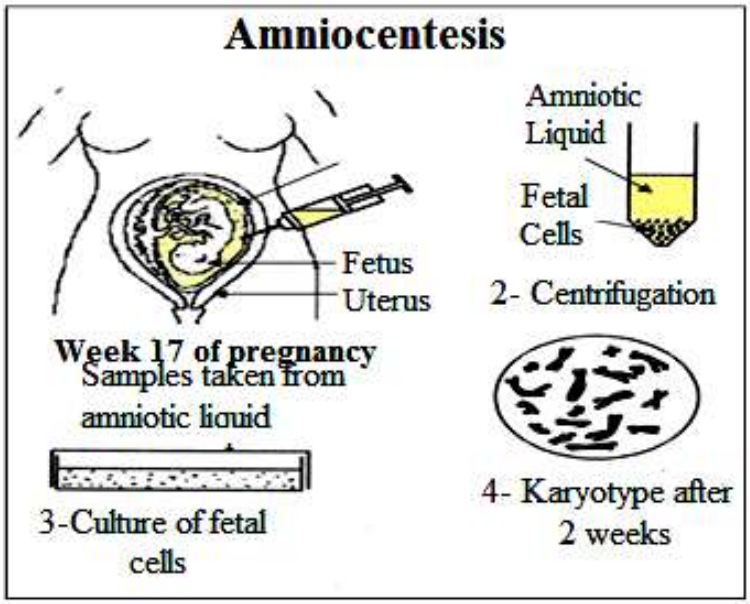
_____

_____

3- Schematize the karyotype of the gamete of this individual.

Activity 3:

- The **Amniocentesis:** a technique which allows taking a sample of the fetal cells in order to produce the karyotype.

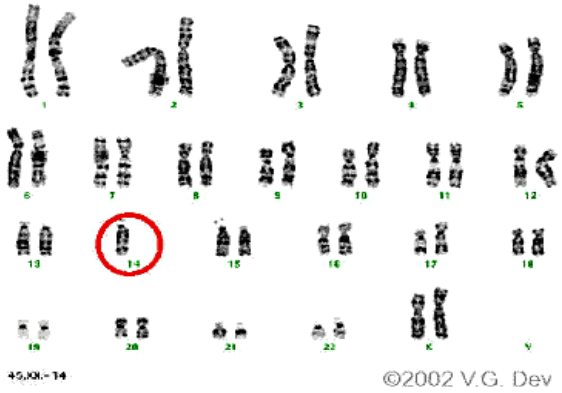


- **The frequent anomalies in the diploid cells:**

  1- Monosomy: when there is only ONE copy of chromosome instead of two.

  Example:

  - Monosomy 14: presence of only 1 copy of chromosome 14 instead of 2 copies:

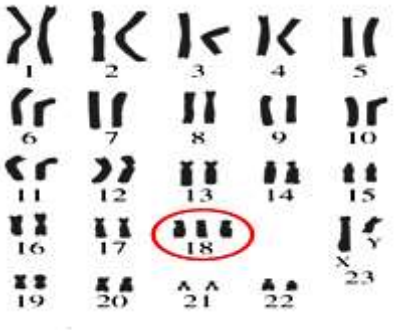


  - Turner Syndrome XO (sexual anomaly): presence of only 1 copy of the gonosome instead of two. This woman is sterile.

  2- Trisomy: when there are 3 copies of chromosomes instead of two.

  Example:

  - Trisomy 18: presence of 3 copies of chromosome 18 instead of 2 copies:

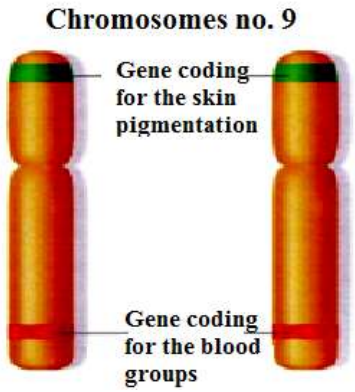


  - Trisomy 21 or Down Syndrome: presence of 3 copies of chromosome 21 instead of 2 copies.

<u>Activity 4:</u>

- **Definition:**
  - **Alleles**: two identical or different versions from the same gene.
  - **Genome**: genes carried by all the chromosomes.
  - **Gene Card:** the distribution of genes on a chromosome.

- **Gene:**
  - It is a part of the chromosome responsible for a hereditary character.
  - Each gene occupies the same locus in the homologous chromosomes.
  - Each chromosome can carry hundreds of genes whose loci are well determined.
  - The **Gene**: a part of the chromosome coding for a <u>specific</u> character:



- **What is the difference between recessive and dominant allele?**
  - A dominant allele is represented by a capital letter. It is always expressed in individuals and hides the recessive allele. Ex: the normal allele N is expressed in 2 combinations: **NN** or **Nm**.
  - A recessive allele is represented by a lowercase letter. It is not expressed if it is presented with a dominant allele. It is expressed when it is presented in the form of 2 alleles. The recessive allele is masked by the normal one. **Ex**: the allele m of a normal person is expressed only in thecombination: **mm**.

- Blood groups (A, B, AB, O) is controlled by the gene situated on chromosome number 9.
  - The gene is found in the form of 3 alleles A, B and O.
  - A and B are always dominant and O is recessive.
  - When A and B coexist, they are called codominant.

- **The possible combinations:**

Allele from the mom	Allele from the dad	Blood group of the fetus
A	o	A
A	A	A
B	B	B
B	o	B
o	o	o
A	B	AB

- **Which gene code for the hemoglobin?**

  Hemoglobin is an abundant protein in the red blood cells. It is determined by a gene located on the pair of chr. no. 11 and in the form of two alleles: ***A*** normal and ***s*** sick (sickle cell).

- **<u>Application</u>** :

  1. Schematize the chromosome pair no. 9 and locate, on the long arm, the alleles of an individual of the blood group AB.
  2. Schematize the different combinations of a normal individual and one suffering from sickle cell.