



Subject: Biology

Grade: 12

Section: LS

Teacher: Dr. Abdallah Nassour

Unit: Reproduction and Genetics

**Chapter 2: Transmission of genes and
genetic recombination**

Document 1: Hereditary traits and genes

Objectives

- ❑ Relate the hereditary character to the gene and allele
- ❑ Define and symbolize phenotype and genotype, homozygous and Heterozygous, True breeding line and Hybrid

Hereditary traits are transmitted from parents to offspring by two fundamental processes of sexual reproduction, namely meiosis and fertilization. These traits are controlled by genes which are linearly arranged on chromosomes.

To what extent can the hereditary traits of an individual identify its genotype?

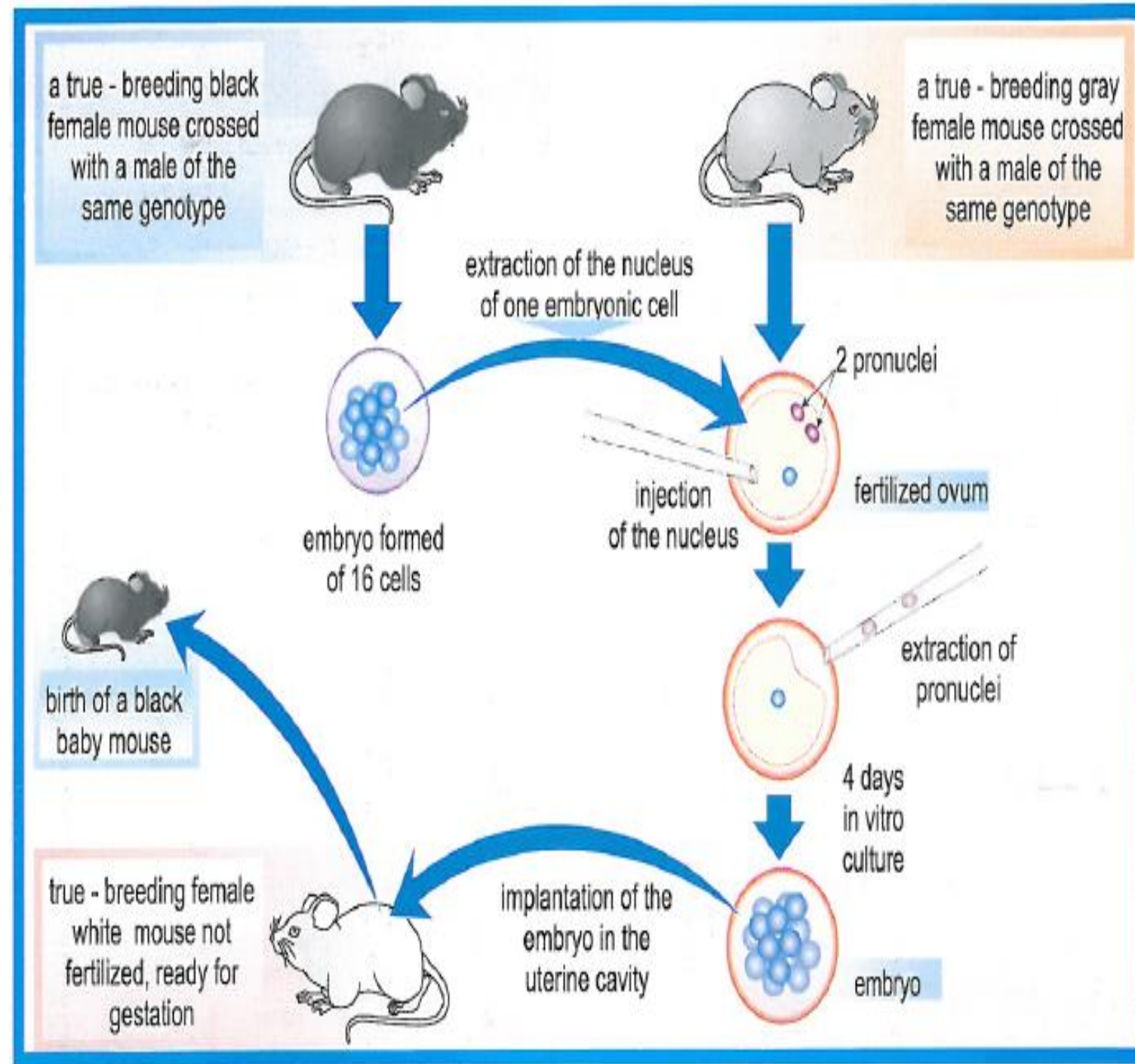
1- Phenotypes and Genotypes

An experiment was performed on mice to locate the genetic information which determines a hereditary trait : **the coat color** for example

What is the problem posed in this experiment?

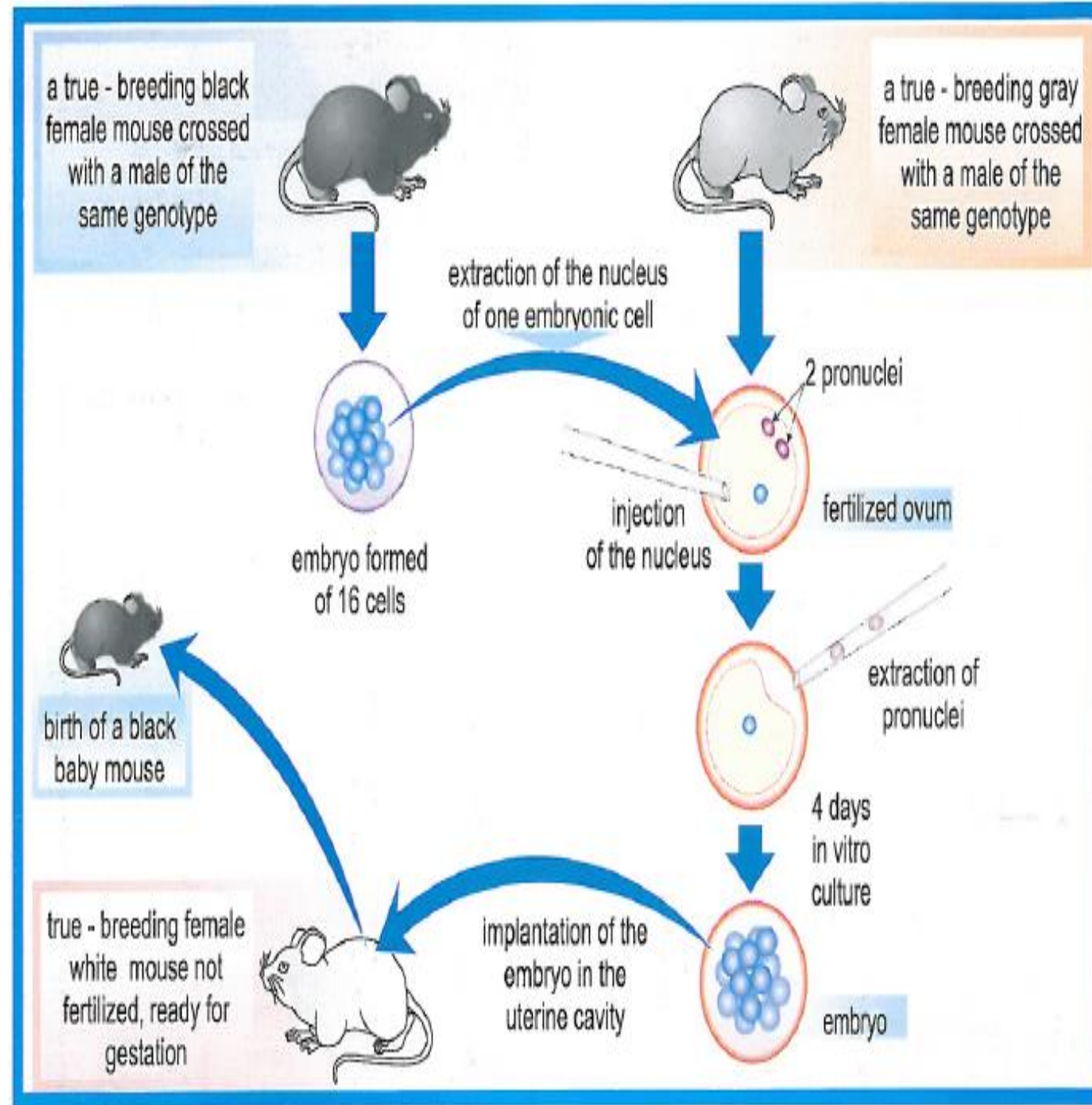
Where is the location of genetic information?

Formulate 2 hypothesis



The experiment shows that the new organism has a black color that is determined by the nucleus of the black mouse. It also shows that the cytoplasm of the fertilized ovum produced by the gray mouse as well as the uterus of the white carrying mice, have not affected the coat color. Therefore, it is the nucleus that is responsible for the coat color of the mice.

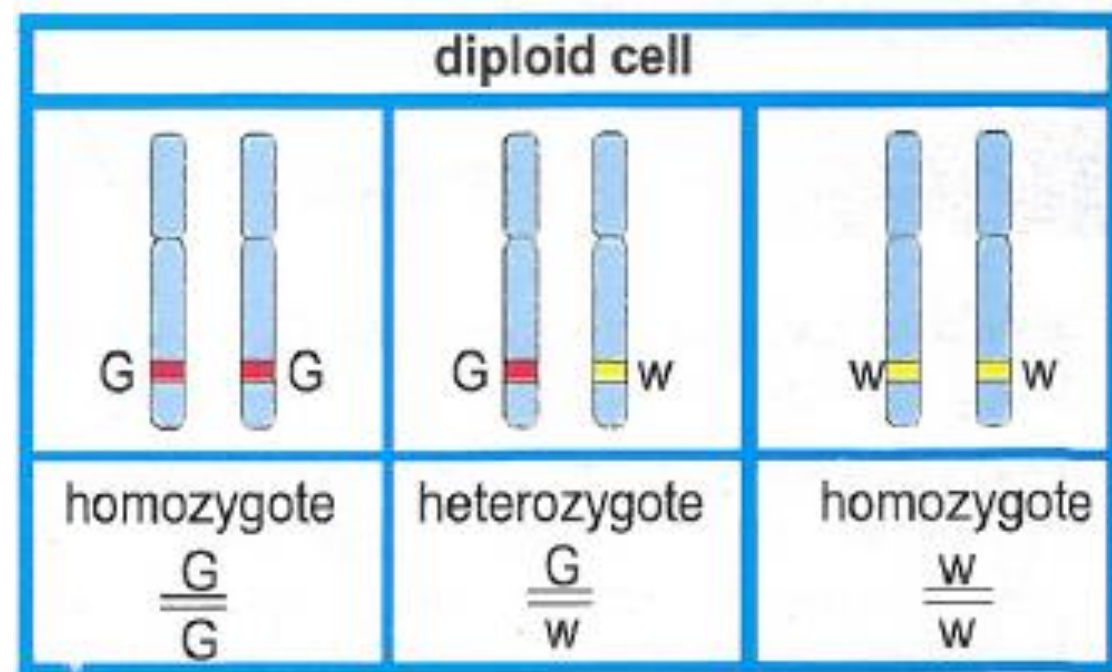
Thus, the genetic information that determines the hereditary traits is located in the nucleus



Symbols of genes:

G: symbol of allele coding for Gray coat color




w: symbol of allele coding for white coat color



Doc.b Chromosomal and allelic illustration for coat color in mice.

- ❖ Nuclei of diploid cells have pairs of each chromosomes ($2n$). Genes located on these chromosomes are thus present in:
- ❖ two identical alleles of a gene are said to be Homozygous for that allele,
- ❖ while organisms having two different alleles are said to be heterozygous for that allele.

The inherited **morphological**, **physiological** and **biochemical** characteristics of an individual are referred to as **phenotype**. They result from the expression of the genotype

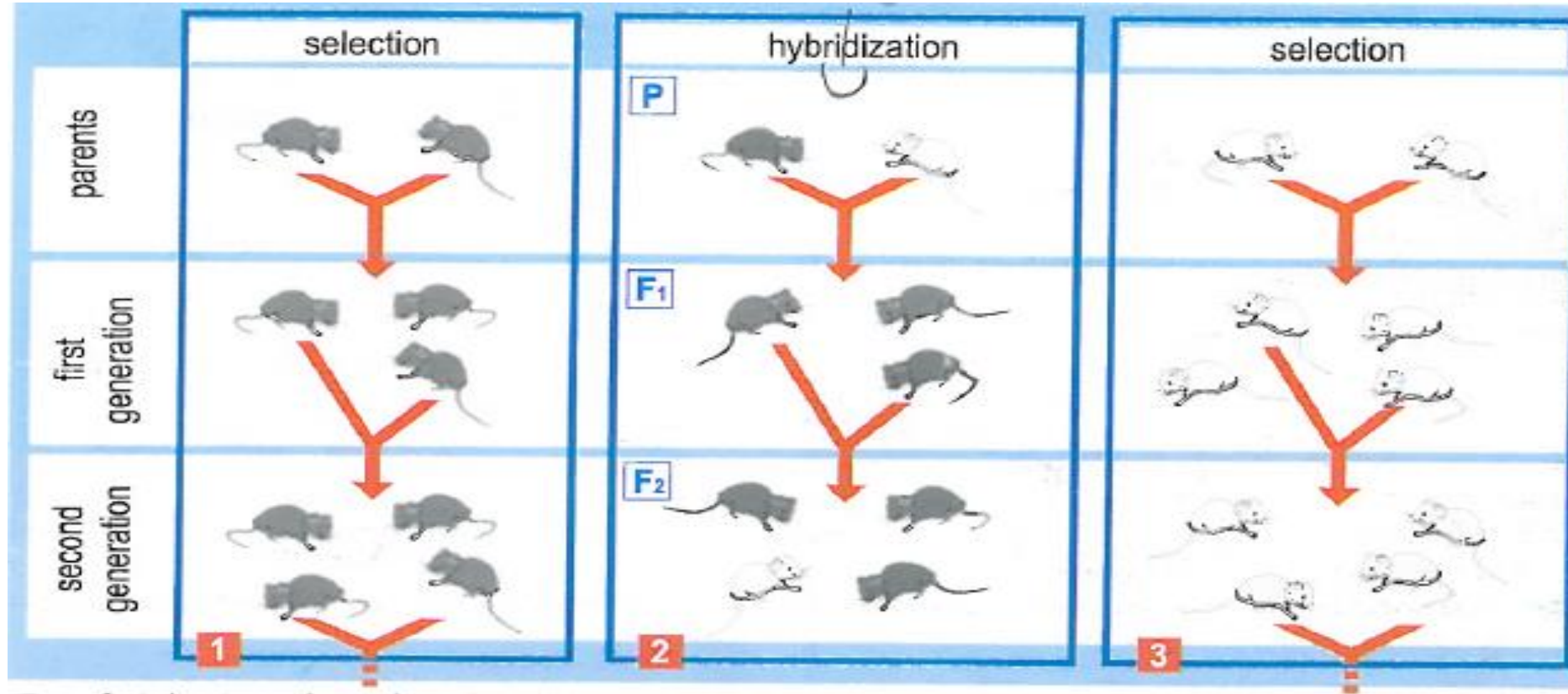
mice	phenotype	genotype
1 	gray or [G]	$\frac{G}{G}$
2 	gray or [G]	$\frac{G}{w}$
3 	white or [w]	$\frac{w}{w}$

Doc.c The phenotype is the expression of the genotype.

Consider the example of two alleles coding for the coat color in mice. The one coding for gray coat color mice is said to be dominant (Capital letter : G). The other coding for white color is said to be recessive (small letter : w)

2- True breeding lines and hybrids

In a breeding of mice, we can select true – breeding lines for a given phenotypic trait, i.e. lines where offspring have always the same trait as their parents for the trait under consideration



Doc.d Selection of true-breeding lines and hybridization.

The crossing of two parents of different true – breeding lines for a given trait leads to the production of **hybrid** offspring. These offspring are the first filial generation F₁.

The cross between members of F₁ generation produces the second filial generation of F₂ and so on F₃, F₄ etc....

- **Alleles**: different versions of a gene
- **Homozygote**: an organism having two identical alleles of the same gene.
- **Heterozygote**: an organism having two different alleles of the same gene.
- **Dominant allele**: allele that is the only one expressed in heterozygotes (symbolized by a capital letter
- **Recessive allele**: allele that is only expressed in homozygote symbolized by a small letter).
- **True-breeding line**: it is a line in which the offspring have always the same phenotype as their parents for a given trait
- **Hybrid**: it is a heterozygote produced by hybridization
- **Hybridization**: It is the experimental crossing of two true-breeding organisms that differ in one or more traits

3. a- Does the phenotype always reveals the genotype? Justify the answer.

No, since in the case of heterozygous gray mice (Dd), their genotypes have two different alleles, white and gray, but the dominant gray allele alone is expressed. The recessive phenotype, because it only appears in the homozygous state,

3. b- Which phenotype unambiguously reveals the genotype? Justify the answer

The recessive phenotype, because it only appears in the homozygous state,

4. How can you be sure of the true – breeding of a line?

A Cross is made between two organisms having the same phenotype. A series of Crosses are then performed between members of the F₁ generation. If the descendants have always the same phenotype as the parents, then it is a true-breeding line

5. How can you explain the presence of white mice in F₂?

Mice of the generation have the white allele which is inherited from the parents but is not expressed. They have transmitted this allele to their offspring in the generation.