Biology Course	Chapitre 9 –Mendelian Heredity	Class: Grade 9

I- Pure Race and Hybrid:

- A **pure race** for a given trait (character) is the group of individuals who present this trait and transmit it to their offsprings.

  Ex : Red Flower (pure race) x Red Flower (pure race) → Red Flower (pure race)

- A **hybrid** is the result of the cross between two individuals belonging to 2 different pure race for the same character.

  Ex : Red Flower (pure race) x White Flower (pure race) → Red Flower(**hybrid**)

- Any hereditary character is controlled by a gene.

  Each gene consists of 2 alleles and each allele comes from a parent by a gamete.

II- Hybridization :

The cross that gives us hybrids is called "**hybridization**".

Experiment :

Peas with red flower (pure race) x Peas with white flower (pure race) → F_1 : Peas with red flower (**hybrid**)

F_1 : Peas with red flower (**hybrid**) x F_1 : Peas with red flower (**hybrid**) → F_2 : 75 % peas with red flower

25 % peas with white flower

Interpretation :

- The red allele is **dominant** and symbolized by « **R** » (capital), because all the obtained peas in F1 have red flowers.
- The white allele is **recessive** andsymbolized by «**w** » (small), because it is masked by the red allele in F1 and reappears in F2.

III- Genotype:

- **Definition** : it is the set of alleles carried by an individual.
- If the alleles are identical, the individual is pure race or homozygote.
  Ex : Genotype of a grey mouse(pure race)is GG or G/G.
  Genotype of a white mouse (pure race) is ww or w/w.

- If the alleles are different, the individual is hybrid or heterozygote.
  Ex : Genotype of a grey mouse (hybrid)is Gw or G/w.

Exercise 1 :

For the handwriting character, the right-handed allele is dominant over the left-handed allele.

a) Designate by symbols the corresponding alleles.
b) Write the genotype of a right-handed individual and another left-handed person.
c) Specify the pure race and the hybrid individuals.

IV-Phenotype:

- **Definition**: it is the expression of the genes (the external appearance).
- It is represented by a capital or a small letter, between brackets.

  Ex : Phenotype of a red flower (pure race) is [R].

  Phenotype of a white flower (pure race) is [w].

  Phenotype of a grey mouse (hybrid) is [G] – genotype Gw or G/w.

Exercise 2:

We cross a pure race grey mouse with a pure race white mouse. All mice obtained in the 1st generation F1 are grey.

a) What conclusion can be drawn from this cross?
b) Symbolize the alleles.
c) *The cross of F1 grey mice (hybrid) among themselves gives in F2: 75% grey mice and 25% white mice.*

   Make the necessary factorial analysis to verify the phenotypic and genotypic results for each cross (F1 and F2).

Exercise 3:

A pure race short-haired guinea pig is crossed with a pure race long-haired guinea pig. All the obtained guinea pigs in F1 are short-haired.

Hybrid guinea pigs are crossed with each other; we obtain ¾ short-haired guinea pigs and ¼ long-haired guinea pigs.

a) Symbolize the alleles.
b) Make the necessary factorial analysis to verify the obtained results.

Exercise 4:

The trait "black eyes" dominates the trait "blue eyes". The marriage of a couple with black eyes gives birth to a child with blue eyes.

a) Designate by symbols the corresponding alleles.
b) How can you explain the appearance of the child with blue eyes from this cross?
c) Make the necessary factorial analysis verifying the experimental results.

Exercise 5:

The cross between two mice having black fur gives F1 descendants constituted of 24 mice with black fur à and 8 mice with white fur.

a) How can you explain the appearance of mice with white fur from this cross?
b) Calculate the proportions of the obtained mice. Then express the results in %.
c) Symbolize the corresponding alleles.
d) Verify, by making the necessary factorial analysis, the experimental results.

V- Test-cross:

The purpose of the test cross is to know if an individual with a dominant phenotype is pure race or hybrid. So, we cross it with an individual of recessive phenotype.

Ex :

Suppose that the grey allele dominates the white allele. The genotype of the grey mouse is then G/G or G/b; and the genotype of the white mouse is b/b.

To find out if the grey mouse is pure race or hybrid, we cross it with a white pure race mouse.

Two cases may occur:

1st case	**2nd case**
P : Grey mouse (PR) x White mouse (PR)	**P :** Grey mouse (RP) x white mouse (PR)
Phenotype : [G] [w]	**Phenotype** : [G] [w]
Génotype : G/G w/w	**Genotype** : G/w w/w
Gametes : 100% G 100 % w	**Gametes** : 50% G 100 % w
F1 : 100 % grey mice	50% w
Genotypic Results : 100% G/w	

Phenotypic Results : 100% [G]

F1 :

	G50%	**w**50%
w	**G/w** 50%	**w/w** 50%

Genotypic Results : 50% G/b 50% b/b

Phenotypic Results : 50% [G] 50% [b]

Exercise 6 :

In Drosophila, the grey body character is dominant with respect to the black body character.

We cross a Drosophila having a grey body with a Drosophila having a black body. We obtain 420 Drosophila with grey body and 418 Drosophila with black body.

a) Calculate the percentages of the obtained Drosophila.
b) What is the type of this cross?
c) Symbolize the corresponding alleles.
d) Verify, by making the necessary factorial analysis, the experimental results.

VI- Non-dominance inheritance or incomplete dominance:

If we cross 2 different pure races for a different trait and we obtain all the individuals with intermediate phenotype, so both alleles are expressed and no allele is completely dominant over the other. They are both symbolized by capital letters.

If we cross the individuals of F1, we obtain 50% of intermediate phenotype, 25% of parental phenotype and 25% of maternal phenotype.

Ex: Intermediate phenotype: *white and red flowers (both dominant: R and W)*

*The combination of **R** and **W** alleles result in a new phenotype which is an intermediate color between white and red (pink).*

Exercise 7 :

We cross of 2 pure races of red and white cattle. All the individuals obtained are roan.

The cross of 2 roan cattle among themselves, gives 50% roan, 25% red and 25% white.

a) Symbolize the corresponding alleles.
b) Verify, by making the necessary factorial analysis, the experimental results.

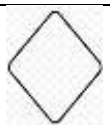
Exercise 8 :

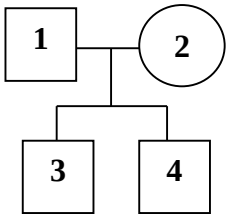
One corn cob contains 26 blue seeds, 25 yellow seeds and 52 purple seeds.

a) Calculate the percentage of seeds in this cob.
b) What conclusion can be drawn from this cross?
c) From what type of cross does this cob of corn come?
d) Verify, by making the necessary factorial analysis, the experimental results.

VII- The Pedigree:

- **Symbols found in Pedigree :**

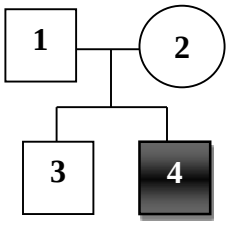
				
Normal male	**Affected male**	**Normal female**	**Affected female**	**Fetus**

- 

Normal parents 1 et 2 have two normal descendants 3 and 4 (two males).

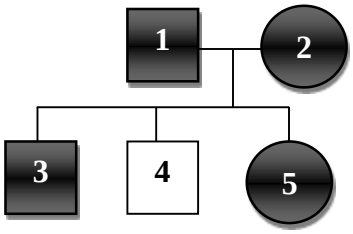
- Hereditary diseases are located on chromosomes as genes.

1. **Autosomal Recessive Disease:** (need the presence of two alleles to be expressed).



- Since parents 1 and 2 are normal but they have child 4 affected, so the disease is recessive.
- Let « **N** » be the normal allele and « **a** » the affected allele.
- Parents 1 and 2 are normal but they have the affected allele masked, their genotype is: **Na**
- The child 4 is affected, his genotype is: **aa**
- The child 3 is normal but can have the affected allele (of the disease), so his genotypes can be : **NN** or **Na**.

2. **Autosomal Dominant Disease :** (need the presence of only 1 affected allele to be expressed).



- Since parents 1 and 2 are affected and they have children 3 and 5 affected, so the disease is dominant.
- Let « **n** » be the normal allele and « **A** » the affected allele.
- Parents 1 and 2 are affected but they have the allele « **n** » masked, their genotype is: **An.**
- Child 4 is normal of genotype: **nn.**
- Children 3 and 5 are affected but may have the normal allele masked, so their genotypes can be: **AA** or **An**.

- **Application :** Solve pp. 162 à 166 # 4 – 5 – 7 – 8 – 9 – 12 – 14 – 15 – 16.

Factorial Analysis:

Parents: **(P1)**	Male Parent: _____	X	Female Parent: _____
Phenotype of parents:			
Genotype of parents:			
Gametes of parents:	♂		♀

F1:

Phenotype:

_____

F1 :

Parents: **(F1)**	Male Parent (F1): _____	X	Female Parent (F1): _____

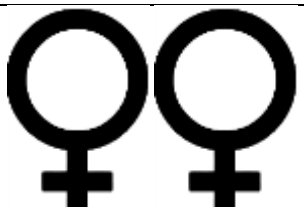
Phenotype of F1:		
Genotype of F1:		
Gametes of F1:		

Table of cross: ***(showing the combination of fertilization of the different gametes of F1).***