APPLICATIONS:

EXERCISE I A cross of rabbits

We cross two true breeding lines of rabbits the first with smooth hair and the other with rough hair
We obtain in the first generation 100 % rabbits with smooth hair.

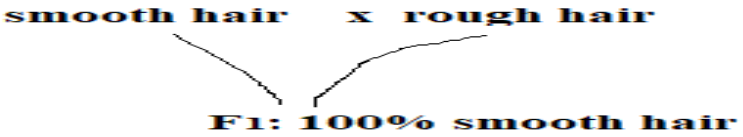
a. Specify the dominant allele and the recessive one.
b. Designate these two alleles by symbols.
c. Indicate the genotypes of the parents and that of the F1.

Two rabbits of the first generation are crossed, we obtain 25 % of rabbits with rough hair.

a. Make the factorial analysis to verify the phenotypic percentage of the offspring with rough hair obtained by this cross.

We cross a rabbit of the F1 with a rabbit of rough hair.

b. Make the factorial analysis that permits us to determine the phenotypic percentages of their offspring



1) Smooth allele(S) dominates the rough allele since the cross between true breeding rabbits with smooth hair and rough hair gives 100% rabbits with smooth hair. Each rabbit of F1 inherited allele S and allele r from the parents but only the smooth allele is expressed in the phenotype.
2) S ⟶ smooth allele (dominant)
   r ⟶ rough allele (recessive)
3) Parents : SS and rr
   F1 : Sr

F1 x F1

25% [r]

4) - Genotype of parents: Sr x Sr

   -Gametes of parents: S 50% r50% S50% r50%

   - Punnet's square :

♀ \ ♂	S 50%	r 50%
S 50%	SS 25%	Sr 25%
r 50%	Sr 25%	rr 25%

25% rabbits with rough hair ⟹ the results are verified.

5) F1 x rough

-Parents : Sr x rr

-Gametes: S 50% r50% r 100%

-Punnet square:

♀ \ ♂	S 50%	r 50%
r 100%	Sr 50%	rr 50%

Phenotypic percentages: 50% [S]
50% [r]

Case of codominance:

EXERCISE 2 Transmission of the color in guinea pigs

Two guinea pigs, the first of white color and the second of yellow color are crossed. All the descendants of these two guinea pigs are yellow-spotted white.

1. Justify that the two crossed guinea pigs are of pure races.
2. Name the generation obtained from the cross of the two guinea pigs.
3. Indicate if this is the case of dominance or codominance. Justify.
4. Designate the alleles of the guinea pig color gene by symbols.

We cross two yellow spotted white guinea pigs of the offspring obtained above, we obtain the following results:

12 yellow spotted white guinea pigs.
6 white guinea pigs.
6 yellow guinea pigs.

5. Calculate the percentages of the results obtained.
6. Perform the factorial analysis to verify the phenotypic percentages of the offspring of this last cross.

White color x yellow color

F1: 100% yellow-spotted white

1) The cross shows that all individuals of F1 generation are uniform of yellow –spotted white. This result is compatible with Mendel's 1st Law "Law of uniformity of F1". Moreover, there is absence of white color or yellow color in F1. So the crossed guinea pigs are pure.
2) F1 generation
3) This is the case of codominance; since each individual of F1 inherited yellow allele and white allele(since the parents are pure). We notice that both alleles are expressed in the phenotype independently and new phenotype appears that differs from parental phenotypes.
4) W ⟶ white allele(dominant)
   Y ⟶ yellow allele (dominant)

[WY] x [WY]

12 [WY]
6 [W]
6 [Y]

5) Percentage of yellow-spotted with white=$\frac{12}{}$ x 100=50%

Percentage of white = 6 x 100=25%
24

% of Yellow = 6 x 100= 25%
24

Note: if they ask to calculate the proportions :

Spotted : 12 = 2
24 4

White : 6 = 1
24 4

Yellow : 6 = 1
24 4

6) – Genotypes of parents: WY x WY

- Gametes of P: W 50% Y 50% W 50% Y 50%

- - Punnet's square:

♀ \ ♂	W 50%	Y 50%
W 50%	WW 25%	WY 25%
Y 50%	WY 25%	YY 25%

- Phenotypic results: 25% [W]
50% [WY]
25% [Y] The results are verified

Question 3: A cross of fruit fly

We want to study the transmission of the trait "size of wings" in the fruit fly. This gene has two alleles. The allele that determines the long wings that is dominant and the allele that determines the short wings that is recessive.

By referring to the text:

1. Indicate the studied gene and its two alleles.
2. Designate by symbols the two alleles of the studied gene.

The genotype of the fruit fly is represented by two letters: each letter refers to one allele.

3. Explain why is the genotype of the fruit fly represented by two letters.
4. Write the genotypes of a fruit fly having short wings. Justify.

Two gray heterozygous fruit flies are crossed.

5. Indicate the genotypes of these two fruit flies.
6. Make the factorial analysis that permits to determine the proportions of the genotypes and the phenotypes of their offspring.

1. The studied gene is the gene of the size of the wings.
   The alleles are: the allele that determines the long wings and the allele that determines the short wings.
2. Long: L (dominant). Short: s (recessive).
3. The genotype of the fruit fly is represented by two letters since it has two alleles one of them is paternal and the other is maternal each one of them is located on one of the two homologous chromosomes carrying the gene of the size of the wings.
4. ss. Since the allele that determines the short wings is recessive expressed only in homozygous state.
5. Ls x Ls

6.

Parents phenotypes: ♀ Long x ♂ Long
Parents genotypes: L//s x L//s

Gametes: L ½ s ½ L ½ s ½

Table of cross

♀ \ ♂	L ½	s ½
L ½	L//L ¼	L//s ¼
s ½	L//s ¼	s//s ¼

Results: Genotypes: L//L ¼ L//s ½ s//s ¼
Phenotypes Long ¾ Short ¼

Question 4: A cross of mice

The gene of fur color in a species of mice has two alleles, the first coding for black fur and the second coding for yellow fur. We decide to study the transmission of the color of fur in these mice; the table below shows the results of many crosses.

Cross	Mouse 1	Mouse 2	Result
1	Yellow	Yellow	Some black mice are obtained
2	Yellow	Black	½ Yellow mice ½ Black mice
3	Yellow	Yellow	2/3 Yellow mice 1/3 Black mice

1. Determine, starting from cross 1, the dominant allele and the recessive allele of the fur color.
2. Justify that the mouse of yellow fur crossed in cross 2 is heterozygous.
3. Formulate a hypothesis to explain the result obtained in cross 3.
4. Make the factorial analysis that validates your hypothesis.

1. In the cross 1, two yellow mice are crossed, we obtain in the result some black mice, this means that the two yellow mice carry the allele of black fur that was hidden in them, so the allele responsible for black fur is recessive and that of the yellow fur is dominant.
2. In cross 2 a yellow mouse is crossed with a black mouse, we obtain in the offspring black mice that carry each two alleles of black fur since the allele of black fur is recessive can be expressed only in homozygous state. So each one of the black mice had inherited one of the alleles of black fur from the mouse of black fur and the other from the mouse of yellow fur that carries also the allele of yellow fur and thus it is heterozygous.

3. Hypothesis: The allele coding for yellow fur is lethal.
4. Let Y be the symbol of the allele responsible for yellow fur which is dominant and b the symbol of the allele responsible for black fur which is recessive.

Phenotypes ♀ yellow mouse x ♂ yellow mouse

Genotypes ♀Y//b x ♂ Y//b

Gametes Y ½ b 1/2 Y 1/2 b ½

Table of cross:

♀ \ ♂	Y 1/2	b 1/2
Y 1/2	Y//Y Dies	Y//b 1/3
b 1/2	Y//b 1/3	b//b 1/3

Phenotypes of the offspring: Yellow 2/3
Black 1/3

So, the phenotypic proportions are verified and thus the hypothesis is validated.