Subject: Biology

Grade: 12

Section: LS

Unit: Reproduction and Genetics

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Chapter 2: Transmission of genes and genetic recombination

Document 2: Transmission of allelic genes

Meiosis and fertilization ensure the transmission of maternal and paternal chromosomes to the offspring. The experimental crossing of two true-breeding organisms that differ only in one trait is called a monohybrid cross or monohybridism. How is a hereditary trait transmitted to the next generation?

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1- Transmission of alleles to the offspring

In a breeding of mice, crosses were performed between true-breeding lines, a gray female and a white male. Many crosses were performed in order to obtain enough offspring, so that the results obtained will be of a statistical value (Doc.a).

Generation	number of the litter	total number of offspring	number of whites and %		number of grays and %	
F_1	1	8	0	0	8	100
F_2	1	12	2	16.6	10	84.3
	2	10	3	30	7	70
	3	8	2	25	6	75
	4	11	3	27	8	33
	5	12	4	33	8	66
total of 5 litters		53	14	26.4	39	73.6

***Doc.a** Statistical distribution of F1 and F2 generations.*

1. How can you explain the statistical results obtained in the F1 and F2 generations of mice)doc.a)?

The first cross gives a homogeneous F1 generation: the gray phenotype observed that of one of the parents. The genotype of the descendants of the F2 is heterozygous, and since the gray allele is expressed, it is dominant over the white allele. second cross gives a heterogeneous F2 generation, with two phenotypes at differ percentages:

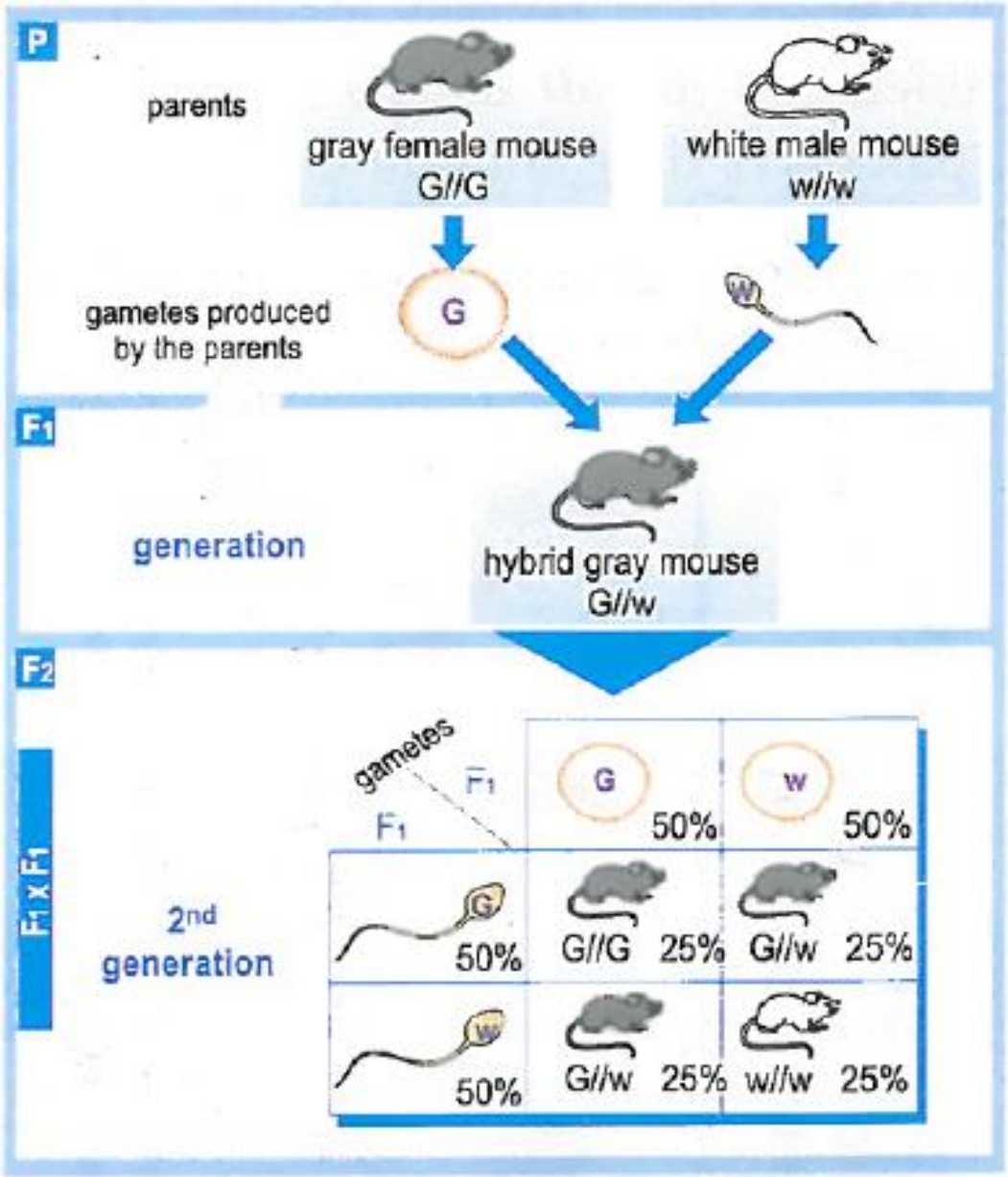
- 75% dominant parental phenotype (like that of Fil with two genotypes, one homozygous and the other heterozygous.
- 25% recessive phenotype, with a homozygous genotype

What information can we draw out from the obtained results? Doc.c

- Parents of F1 are pure
- F1 generation is hybrid
- Gray color allele dominates the white color alleles

symbols of genes

- Let G be the symbol of the dominant allele for gray color.
- Let w be the symbol of the recessive allele for white color.



Doc.c Transmission of alleles in case of dominance (factorial analysis).

Make a factorial analysis to verify the results of in doc. c

Phenotypes of parents: ♂ Gray X ♀white

Genotypes of parents: ♂ GG x ♀ ww

Gametes: G w

Genotypes of F1: Gw 100%

Genotypes of parents (F1) : Gw X Gw

Gametes: G w G w

50% 50% 50% 50%

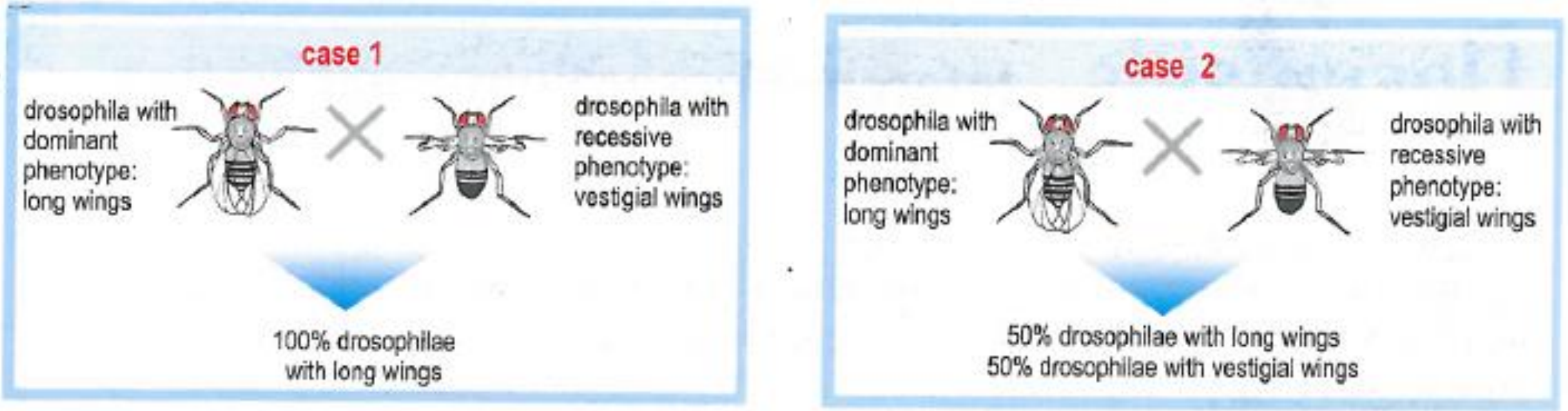
♂ ♀	G 50%	w 50%
G 50%	GG 25 %	Gw 25 %
w 50%	Gw 25 %	ww 25 %

Genotypes:
GG: 25 %
Gw: 50%
ww: 25%

Phenotypes:
Gray : 75 % or [G]
White: 25% or [w]

2- Test cross

A test-cross is performed in order to find out whether an organism that exhibits a dominant trait is **homozygous** or **heterozygous** for that trait. **It consists of crossing that organism having a dominant trait with an organism having a homozygous recessive** trait that only produces one type of gametes carrying the recessive allele. Therefore the phenotype of the offspring reveals with no doubt the type of allele carried by the gametes of the parent to be tested



Doc.d Test-cross in drosophilae.

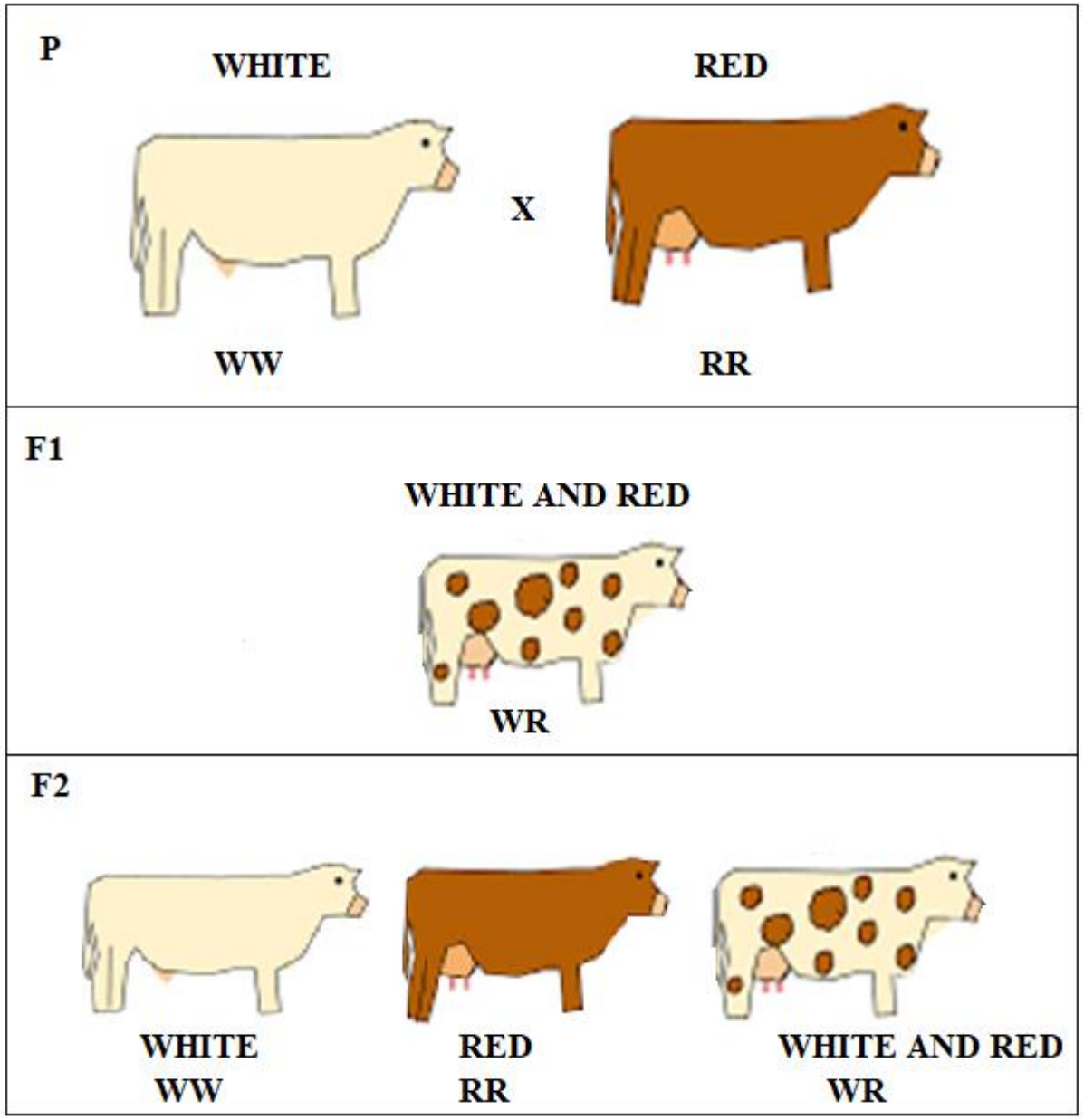
2. Specify the genotypes of the parents in both cases represented in doc.d. Justify the answer.

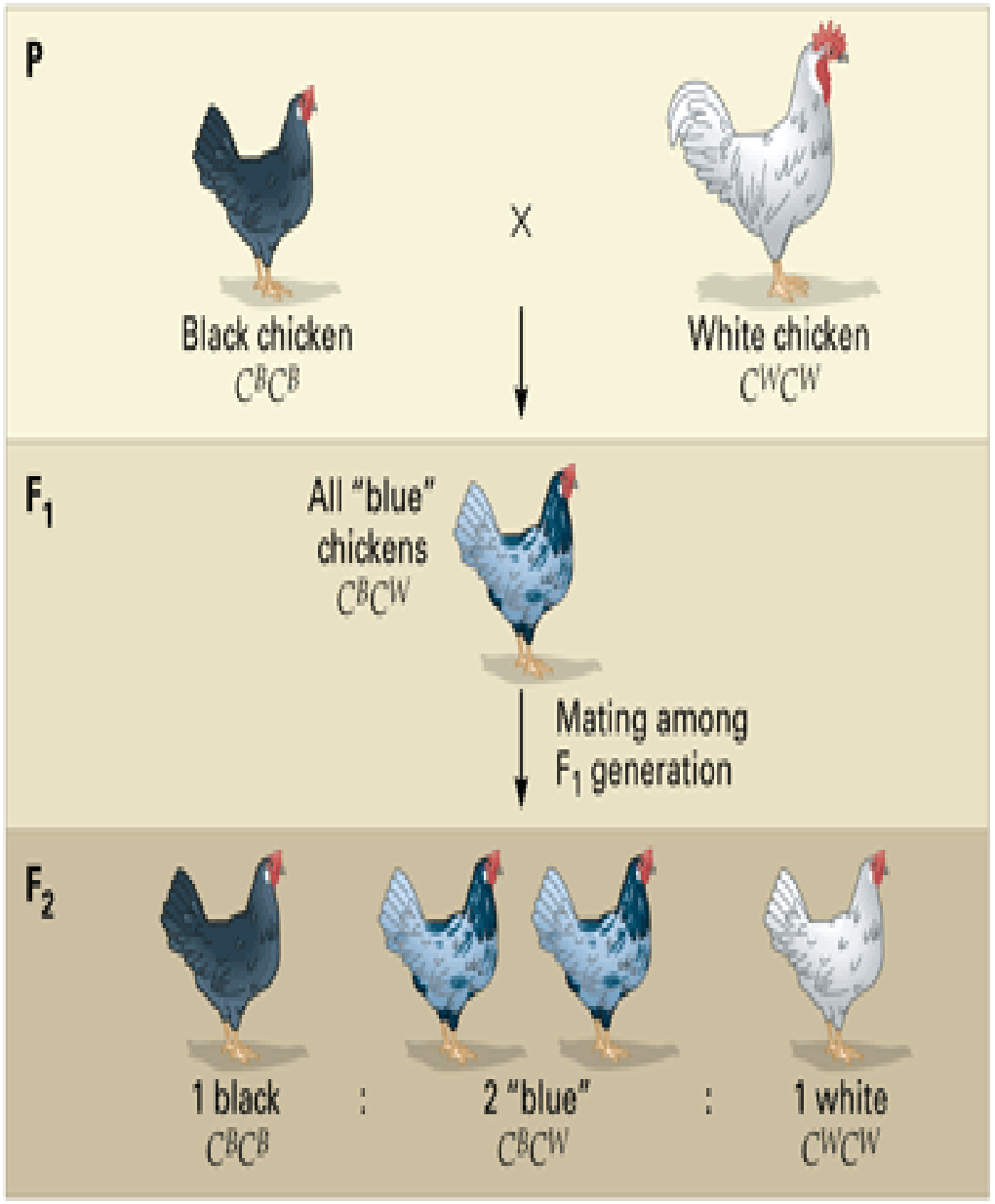
L: symbol for long wings v symbol for vestigial wings
The genotype of the drosophila having vestigial wings is v//v because the recessive phenotype is only expressed at the homozygous state in both cases

Case 1:
The genotype of the drosophila having long wings is : L//L because all descendant have long wings; they have for sure inherited an allele v from one parent and another allele L from the other parent. The parent having long wings has only given on type of gametes carrying alleles L

Case 2:
The genotype of the drosophila with long wings is L//v, since the descendant's contain vestigial wings (50%) have two alleles v, each one being inherited from each parent.

3- Transmission of alleles in case of codominance and incomplete dominance





Are these cases a dominant cases? Justify your answer.

No , because the offspring are not identical to one of the parents

- Incomplete dominance is when the phenotypes of the two parents blend together to create a new phenotype for their offspring. An example is a white flower and a red flower producing pink flowers.

- Codominance is when the two parent phenotypes are expressed together in the offspring. An example is a white flower and a red flower producing offspring with red and white patches

Make a factorial analysis to verify the results in the case of codominance

Phenotypes of parents: ♂ white X ♀Red

Genotypes of parents: ♂ WW x ♀ RR

Gametes: W R

Genotypes of parents (F1) : WR X WR

Gametes: W R W R

50% 50% 50% 50%

♂ ♀	W 50%	R 50%
W 50%	WW 25 %	RW 25 %
R 50%	RW 25 %	RR 25 %

Genotypes:
WW: 25 %
RR: 25%
WR: 50%

Phenotypes:
Red : 25 % or [R]
White: 25% or [W]
White and red 50% [RW]

Make a factorial analysis to verify the results in the case of non- codominance

Phenotypes of parents: ♂ black X ♀white

Genotypes of parents: ♂ BB x ♀ WW

Gametes: B W

Genotypes of parents (F1) : BW X BW

Gametes: B W B W

50% 50% 50% 50%

♂ ♀	B 50%	W 50%
B 50%	BB 25 %	BW 25 %
W 50%	BW 25 %	WW 25 %

Genotypes:
BB: 25 %
BW: 50%
WW: 25%

Phenotypes:
Black : 25 % or [B]
White: 25% or [W]
Blue: 50 % [BW]

4- Transmission of lethal alleles

Specify the cross that determine the dominant and the recessive alleles?

The second cross. Because the cross between 2 yellow gives black offsprings which means that the black allele is hidden in the parents. So, Black is recessive and yellow is dominant.

Mice crosses	Parents		Offspring
	Female	Male	
1st	Black	Black	Black
2nd	Yellow	Yellow	2/3 yellow 1/3 black
3rd	Yellow	Black	½ yellow ½ black

The cross between 2 hybrid individuals gives 75% dominant phenotypes and 25 % recessive phenotypes . How can you explain the results in the 3rd cross. By using factorial analysis

Genotypes of parents (F1) : Yb X Yb

Gametes: Y b Y b

½ ½ ½ ½

Phenotypes:
yellow : ¾
black: ¼

Phenotypes of the 3rd cross:
Yellow : ⅔
black: ⅓

♂ ♀	Y ½	b ½
Y ½	YY ¼	Yb ¼
b ½	Yb ¼	bb ¼

The result of the 3rd cross is differ from the expected results,

By comparing the 2 results. The black phenotype is 1 in the two results. So no missing phenotype for black.

But the phenotype for yellow is ⅔ and not ¾. This means that there is a missing in the yellow phenotypes. If the missed phenotype is Yb the result will be ½ black and ½ white , Which is not the case . So the missing phenotype is YY.

When the organism is homozygous for the yellow allele the organism dies because in the homozygous form it is a **lethal allele**