

1. A fly species has a XX/XY sex determination system similar to humans. You have identified mutants that have mini wings and bright-red eyes. To examine the mode of inheritance of the two traits you perform the crosses outlined in the table below beginning with flies from two pure-breeding populations. **(17 marks total)**

Table 1. Phenotypes of parents and the phenotypes and numbers of offspring.

<u>Parents (P₁)</u>	<u>F₁ offspring</u>		<u>F₂ offspring (offspring of F₁x F₁)</u>	
Phenotypes	Phenotypes	#	Phenotypes	Number
Female: bright-red eyes, normal wings	Females: normal eyes and normal wings	45	Female bright-red eyes, normal wings Female normal eyes, normal wings Male bright-red eyes, normal wings Male normal eyes, mini wings	504 493 527 480
Male: normal eyes, mini wings	Male bright-red eyes and normal wings	50	Male bright-red eyes, mini wings Male normal eyes, normal wings	1 2

For the questions below you will be asked to evaluate specific hypotheses for the mode of inheritance of the traits. The mode of inheritance may or may not be consistent with the data.

Based on the results from the F₁ offspring, you initially hypothesize that inheritance of mini-wings is autosomal and recessive.

- a) Under the hypothesis that the mini-wing allele is autosomal recessive, define your alleles for the wing gene. **(0.5 marks)**

W = wing gene W^M = mini-wing allele W^N = normal wing allele

- b) Under the hypothesis that the mini-wing allele is autosomal recessive, define **all** genotypes and their associated phenotypes **(1.5 mark)**.

Females and Males W^M W^M = mini winged individuals

Females and Males W^N W^N and W^N W^M = normal winged individuals

- c) Under the hypothesis that the mini-wing allele is autosomal recessive, complete a Punnett Square showing your predictions for the genotypes and phenotype frequencies for the P₁ cross, and the F₁ cross giving the resulting F₂ generation **(3 marks)**

		Female Parent	
		W^N	W^N
Male Parent	W^M	$W^N W^M$	$W^N W^M$
	W^M	$W^N W^M$	$W^N W^M$

F1 All individuals have normal wings

		Female Parent (F1)	
		W^N	W^M
Male Parent (F1)	W^N	$W^N W^N$	$W^N W^M$
	W^M	$W^N W^M$	$W^M W^M$

F1 For both males and females we would expect a 3:1 ratio of normal to mini wings

- d) Is the hypothesis that the mini-wing allele is autosomal recessive supported by the data (yes or no)? Briefly explain why or why not with specific reference to your predictions and the data. Two to three sentences max. **(2 marks)**

No, for the F2 generation we would expect a 3:1 ratio of normal to mini for both males and females. However, we see 100% normal winged females. For males we have 50% mini and 50% normal. The observed phenotypic ratios differ from the expected under the hypothesis of the mini-wing allele being autosomal recessive.

- e) Which hypothesis for inheritance of mini-wings is consistent with the data? (explanation not required) **(1 mark)**.

Mini wings are X-linked recessive

- f) Which modes of inheritance are possible or not possible for the trait bright-red eyes? **(2 marks)**

Autosomal Dominant	Possible / Not Possible
Autosomal Recessive	Possible / Not Possible
X-linked Dominant	Possible / Not Possible
X-linked Recessive	Possible / Not Possible

- g) What evidence led you to your conclusion for the mode of inheritance in “e”. (1 mark)

Males and females differ in their phenotypes in the F1 generation.

- h) Why are there so few males with bright-red eyes and mini wings? (1 mark)

Crossing over between the wing and eye genes is required. The genes are close together on the X chromosome so crossing over is rare.

- i) What process was responsible for producing males with bright-red eyes and mini wings? (1 mark)

Crossing over

- j) When does this process occur? (1 mark)

Late prophase 1 in the F1 females

In flies, the normal eye color is due to the presence of brown and red pigments. If the brown pigment is absent, the eyes appear bright red. The amount of brown pigment was quantified in female flies from the above crosses and an additional pure breeding female fly from another experiment.

Female Flies	Phenotype	Brown Pigment Amount
P1	Bright red	0.2 units
F1	Normal eyes	0.7 units
Pure breeding	Normal eyes	1.2 units

- k) Does this new information affect your conclusions about the mode of inheritance of eye color? Briefly explain your reasoning. (2 marks).

The alleles are non-dominant (or incompletely dominant / codominant)

Drosophila melanogaster is a diploid organism of $2N=8$. It has 3 pairs of autosomes and 1 pair of sex chromosomes. Crossing over does not occur in males but does occur in females.

- l) Even though crossing over does not occur in males, what processes would contribute to genetic variation among gametes? (**1 mark**)

Independent assortment.

- m) When does the process indicated in “m” occur (be as specific as possible)? (**1 mark**)

Anaphase of meiosis I