

## 19/11 MORGAN'S EXPERIMENT

Morgan selected a species *Drosophila melanogaster*.

Fruit flies are prolific breeders.

They have 4 pairs of chromosomes.

3 pairs are autosomes and 1 pair is sex chromosome.

He detected a mutant fly, a male with different characteristics. The eyes were white instead of red.

- He first crossed the mutant male to a normal female to see which was dominant.
- All F1 progeny had red eyes.
- Then he crossed flies from F1 gen with each other.
- Eye colour in F2 gen was segregated in an imperfect 3:1 ratio just as Mendel predicted.
- But strangely all white-eyed flies in F2 generation were males.

$RR \times rr$

$Rr$

$RR \quad Rr \quad Rr \quad rr$   
 Red                      White

He test-crossed one of the red-eyed F1 females back to the original white male.

He obtained both white and red-eyed males and females.

$\therefore$  White-eyed females were possible.

- The solution to this lies in the fact that in *Drosophila*, the white eye trait resides on the X chromosome and is absent from the Y chromosome.
- Now we know Y chromosome carries almost very less functional genes. Y-linked gene X chromosome contains >1000 genes, which are called X-linked genes knowing that the white eye trait is recessive to the red eye trait.  $\therefore$  This was a natural consequence of Mendelian assortment of chromosomes.
- The trait determined by X chromosome is said to be X-linked.

$X^w Y \rightarrow$  white male

$X^R X^R \rightarrow$  red eyed female  
 (homozygous dominant female)

	$X^w$	Y
$X^R$	$X^R X^w$	$X^R Y$
$X^R$	$X^R X^w$	$X^R Y$

—  $F_1$

$X^w Y - X^R X^w$  — ~~homozygous~~  
 (Test cross)

	$X^w$	Y
$X^R$	$X^R X^w$	$X^R Y$
$X^w$	$X^w X^w$	$X^w Y$

$\downarrow$  white eyed female  
 $\rightarrow$  Red white eyed male.



Drosophila experiments for body colour and wing size.

Wild type flies have gray bodies and normal-sized wings. Double mutant flies have black bodies and wings much smaller than normal called vestigial wings.

Mutant alleles are recessive to wild type alleles.

The alleles for body colour are  $b^+$  (gray) and  $b$  (black) and for wing size  $vg^+$  (normal) and  $vg$  (vestigial).

Morgan true-breeding P (parental) generation flies wild type flies with black, vestigial winged flies - to produce heterozygous.

F1 dihybrids ( $b^+b, vg^+vg$ ), all of which are wild in appearance.

He then mated F1 wild F1 dihybrid females with black, vestigial winged males (test cross).

For test cross:

Genotypic/Phenotypic ratio

If genes are located on different chromosomes.  
 (Mendel's)

1 : 1 : 1 : 1

If genes are located on same chromosome and parental alleles are always inherited together. (Morgan's)

1 : 1 : 0 : 0

Some alleles do not assort independently.