

GENETICS: Drosophila Types and Crosses

Southern Biological offers a variety of Drosophila types. The below crosses are a demonstration of appropriate modes of inheritance.

| Type | Chromosomes | Description |
|---------------------|-------------|--|
| Wild type (+) | N/A | Designated wild type because it is the characteristic phenotype found in flies in nature. |
| Ebony Body (e) | (3-70.7) | Recessive trait: body colour is shining black. Viability compared to wild type is about 80%. |
| Vestigial Wing (vg) | (2-67.0) | Recessive trait: wings reduced to vestiges and usually held at right angles to the body. Viability somewhat reduced. |
| White Eye (w) | (1-1.5) | Recessive trait carried on the sex chromosome (chromosome 1): eyes are pure white. |

Note: All Phenotypes are due to single mutations.

1. Monohybrid Cross: Homozygous Wild type x Homozygous Vestigial Wing

Parental Generation (P)



First filial Generation (F1)

| | | |
|---|-----|-----|
| | vg | vg |
| + | +vg | +vg |
| + | +vg | +vg |

| | |
|------------------|----------------------------|
| Phenotypic Ratio | All Normal wild type wings |
| Genotypic Ratio | All +vg Heterozgous |

Selfing the F1 provides an F2 Generation



Second filial Generation

| | | |
|----|-----|------|
| | + | vg |
| + | ++ | +vg |
| vg | +vg | vgvg |

| | |
|------------------|--|
| Phenotypic Ratio | 3/4 normal wildtype wings 1/4 vestigial wings |
| Genotypic Ratio | 1:2:1 1/4 homozygous wild type 2/4 heterozygous wild type 1/4 homozygous vestigial wing |

2. Monohybrid Cross: Homozygous Wild type x Homozygous Ebony body

Backcrossing refers to crossing (mating) heterozygous offspring (F1) with one of its recessive mutant parents. Backcrossing the F1 generation with the homozygote recessive mutant is another cross that can be set up to demonstrate the mode of inheritance. In this case, the back-cross progeny would be expected to segregate into two classes (mutant and wild type) of equal size.

Parental Generation (P)

| | | |
|-------------------------|---|----------------------------|
| ++ Homozygous Wild Type | X | ee (Homozygous Ebony Body) |
|-------------------------|---|----------------------------|

First filial Generation

| | | |
|---|----|----|
| | e | e |
| + | +e | +e |
| + | +e | +e |

| | |
|------------------|---------------------------|
| Phenotypic Ratio | All wild type body colour |
|------------------|---------------------------|

Backcrossing the F1 provides an F2 Generation

| | | |
|-------------------|---|-------------------------------------|
| +e (Heterozygous) | X | ee (Homozygous Ebony bodied parent) |
|-------------------|---|-------------------------------------|

Second filial Generation (F2)

| | | |
|---|----|----|
| | e | e |
| + | +e | +e |
| e | ee | ee |

3. Sex linked Genetic Cross: Homozygous White eyed Mutant x Homozygous Wild type

This is a monohybrid cross for a character that is determined by a single sex-linked genetic locus. The White eyed mutant is used in these crosses. In this case the sex of the fly carrying the mutant locus will influence your results in the F1. Therefore, you will need to set up a reciprocal cross. Reciprocal crossing refers mating a male and a female that have different phenotypes, and then conducting a second set of crosses, in which the phenotypes are reversed relative to the sex of the parents in the first cross. Sex linkage usually explains reciprocal crosses giving different results as well as; the male and female offspring exhibiting different phenotypes. Below is an example of a genetic notation format you may like to use when performing these crosses.

| | |
|-----------|-------------------------------|
| $X^+ X^+$ | WT, wild type red eye, female |
| $X^w X^w$ | WE, white eye, female. |
| $X^+ Y$ | WT, wild type red eye, male. |
| $X^w Y$ | WE, white eye, male. |

Example One: Parental Generation (P)

| | | |
|--------------------------|---|--|
| $X^w Y$ White Eyed Males | X | $X^+ X^+$ Wild Type Females (Red eyes) |
|--------------------------|---|--|

First filial Generation (F1)

| | | |
|-------|-----------|---------|
| | X^w | Y |
| X^+ | $X^+ X^w$ | $X^+ Y$ |
| X^+ | $X^+ X^w$ | $X^+ Y$ |

| | |
|------------------|-------------------|
| Phenotypic Ratio | All have red eyes |
|------------------|-------------------|

Second filial Generation (F2)

| | | |
|-------|-----------|---------|
| | X^+ | Y |
| X^+ | $X^+ X^+$ | $X^+ Y$ |
| X^w | $X^w X^+$ | $X^w Y$ |

| | |
|------------------|---|
| Phenotypic Ratio | 25% have white eyes 75% have red eyes (50% females have red and 50% males have white) |
|------------------|---|

| | |
|-----------------|-------|
| Genotypic Ratio | 3 : 1 |
|-----------------|-------|

Note: 50% males have red eyes and 50% males have white eyes. All females have red eyes. A fly's eye colour is linked to its sex.

Example Two (Reciprocal Cross): Parental Generation (P)



First filial Generation (F1)

| | | |
|----------------|-------------------------------|------------------|
| | X ⁺ | Y |
| X ^w | X ^w X ⁺ | X ^w Y |
| X ^w | X ^w X ⁺ | X ^w Y |

| | |
|------------------|--|
| Phenotypic Ratio | 50% have white eyes 50% have red eyes |
|------------------|--|

Note: Instead of the 3:1 ratio of the previous example, the ratio is 50% red eye and 50% white eye; with all males exhibiting white eyes.

4. Dihybrid Cross: Homozygous Ebony Body x Homozygous Vestigial Wing

This is a dihybrid cross. A 9:3:3:1, F2 ratio, will be achieved when 2 flies heterozygous for 2 different, unlinked autosomal recessive genes are crossed. To determine the genotypes of the F2, draw up a punnet square, using the possible gametes of the F1. Below is an example of a genetic notation format you may like to use when performing this cross.

| | |
|-----------------|-----------------------|
| e | Ebony body colour |
| e ⁺ | Wild type body colour |
| vg | Vestigial wing shape |
| vg ⁺ | Wild Type wing shape |

Parental Generation (P)



First filial Generation (F1)

| | | |
|-------------------|-------------------------------------|-------------------------------------|
| | e ⁺ vg | e ⁺ vg |
| e vg ⁺ | e vg ⁺ e ⁺ vg | e e ⁺ vg ⁺ vg |
| e vg ⁺ | e vg ⁺ e ⁺ vg | e e ⁺ vg ⁺ vg |

| | |
|------------------|---------------------------------------|
| Phenotypic Ratio | All wild type (normal wings and body) |
| Genotypic Ratio | All Heterozygous |

Selfing the F1 generation provides an F2 generation



| | $e^+ \text{ } vg^+$ | $e^+ \text{ } vg^+$ | $e \text{ } vg^+$ | $e \text{ } vg$ |
|---------------------|------------------------------|-----------------------------------|----------------------------|---------------------------------|
| $e^+ \text{ } vg^+$ | $e^+ e^+ \text{ } vg^+ vg^+$ | $e^+ e^+ \text{ } vg^+ vg$ | $e^+ e \text{ } vg^+ vg^+$ | $e^+ e \text{ } vg^+ vg$ |
| $e^+ \text{ } vg$ | $e^+ e^+ \text{ } vg^+ vg$ | $e^+ e^+ \text{ } vg \text{ } vg$ | $e^+ e \text{ } vg^+ vg$ | $e^+ e \text{ } vg \text{ } vg$ |
| $e \text{ } vg^+$ | $e^+ e \text{ } vg^+ vg^+$ | $e^+ e \text{ } vg^+ vg$ | $e e \text{ } vg^+ vg^+$ | $e e \text{ } vg^+ vg$ |
| $e \text{ } vg$ | $e^+ e \text{ } vg^+ vg$ | $e^+ e \text{ } vg \text{ } vg$ | $e e \text{ } vg^+ vg$ | $e e \text{ } vg \text{ } vg$ |

| | |
|------------------|--|
| Phenotypic Ratio | 9/16 Wild Type 3/16 Ebony bodied 3/16 Vestigial wing 1/16 Ebony Vestigial |
| Genotypic Ratio | 9 : 3 : 3 : 1 |