

## Fruit Fly Exercise 9

### Description of StarGenetics

In this exercise you will use StarGenetics, a software tool that simulates mating experiments, to analyze the nature and mode of inheritance of specific genetic traits.

### Learning Objective

1. Use appropriate genetic analysis to determine the mode of inheritance of two different mutations and the relationship between them.

### Getting started with StarGenetics

- To get to StarGenetics, please navigate to: <http://web.mit.edu/star/genetics/>.
- Click on the **Start** button to launch the application.
- Click **Trust** when a prompt appears asking if you trust the certificate.
- Click on **File → New** in the drop-down menu in the upper left hand corner.
- Click on the **Fruit Fly Exercise 9** file.

You have begun a research project in a genetics laboratory that studies the fruit fly *Drosophila melanogaster*. Your research advisor recently isolated two new mutant flies and gives you the task of analyzing the mode of inheritance of each mutation. She gives you the two true-breeding mutant flies, **Mutant 1** and **Mutant 2**, to analyze. In addition, she also gives you two true-breeding wild-type flies (Wild-type M and Wild-type F). All of the flies can be found within the **Strains box**.

**1** First, describe the phenotype and sex of both mutant flies. Describe the phenotype as it compares to wild type.

- The sex and phenotype of each fly should be visually obvious. You can also obtain this information by clicking on the fly and looking in the **Properties** window.

**Answer**

**2** First, determine whether the mutant phenotype in the Mutant 1 fly is conferred by a dominant or recessive allele.

**a)** Cross the Mutant 1 fly with a wild-type fly. What do you observe?

- Drag each fly to the **Mating Site** and click on the **Mate** button.
- Each resulting offspring can be viewed within the **Individual** tab or a summary of the results is available within the **Summary** tab.

**Answer**

**b)** What do these results tell you about the mutant allele? Does it confer a dominant or recessive phenotype relative to the wild-type phenotype?

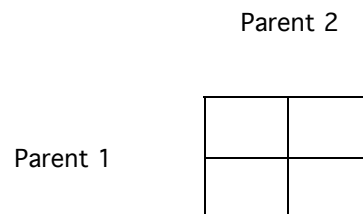
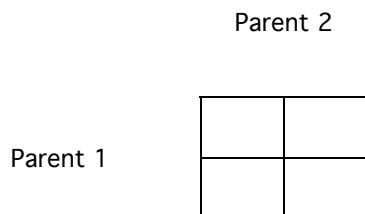
**Answer**

**3** Second, you would like to determine whether the allele that confers the mutant phenotype in the Mutant 1 fly is autosomal or sex-linked.

**a)** To determine if the mutant allele is sex-linked or autosomal, you will need to perform an informative cross. Propose a cross that will help you determine if the mutant allele is sex-linked. Use the Punnett Squares below to diagram the expected progeny for your cross for both the sex-linked and autosomal situations. Indicate the expected genotypic and phenotypic ratios you would obtain in each case.

**Sex-Linked**

**Autosomal**



Expected Genotypic Ratio: \_\_\_\_\_  
Expected Phenotypic Ratio: \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_

**Answer**

Proposed Cross:

**b)** Perform the cross that you proposed in Question 3a in StarGenetics. Fill in your results below. Is the Mutant 1 allele autosomal or sex-linked? Explain.

**Answer**

- \_\_\_\_\_ Wild-type females
- \_\_\_\_\_ Wild-type males
- \_\_\_\_\_ Mutant females
- \_\_\_\_\_ Mutant males

Conclusions:

**4** Now you would like to determine whether the mutant phenotype in the Mutant 2 fly is conferred by a dominant or recessive allele.

- a)** Cross the Mutant 2 fly with a wild-type fly. What do you observe?
- Drag each fly to the **Mating Site** and clicking on the **Mate** button.
  - Each resulting offspring can be viewed within the **Individual** tab or a summary of the results is available within the **Summary** tab.

**Answer**

b) What do these results tell you about the Mutant 2 allele? Does it confer a dominant or recessive phenotype relative to the wild-type phenotype?

**Answer**

**5** You would like to determine whether the allele that confers the mutant phenotype in the Mutant 2 fly is autosomal or sex-linked.

a) Perform the same informative cross that you proposed in Question 3a with the Mutant 2 fly in StarGenetics. Fill in your results below. Is the mutant allele autosomal or sex-linked? Explain.

- Reference the Punnett Squares in Question 3a if needed.

**Answer**

\_\_\_\_\_ Wild-type females

\_\_\_\_\_ Wild-type males

\_\_\_\_\_ Mutant females

\_\_\_\_\_ Mutant males

Conclusions:

**6** Now that you know more about the Mutant 1 and Mutant 2 alleles, it's time to determine whether they are in the same or different genes.

a) Can you perform a complementation test to determine whether the Mutant 1 and Mutant 2 mutations are in the same gene? Why or why not?

**Answer**

b) Design a cross or set of crosses that will utilize differences in genotypic and phenotypic ratios amongst the progeny to determine whether the Mutant 1 and Mutant 2 mutations are in the same gene. Indicate genotypes and phenotypes of the parent flies in each cross. Specify the expected genotypic and phenotypic ratios for the progeny of each cross.

- Remember that in *Drosophila*, meiotic crossing over occurs in females, but not in males.

**Answer**

**b)** Perform the cross(es) in StarGenetics. What results did you obtain? Are the Mutant 1 and Mutant 2 mutations in the same gene?

**Answer**

**7** Are the Mutant 1 and Mutant 2 alleles linked?

**a)** Design a cross or set of crosses to determine whether the Mutant 1 and Mutant 2 alleles are linked. Indicate genotypes and phenotypes of the parent flies in each cross. Specify the expected genotypic and phenotypic ratios for the progeny of each cross.

- Remember that in *Drosophila*, meiotic crossing over occurs in females, but not in males.

**Answer**

**b)** Perform the cross(es) in StarGenetics. What results did you obtain? Are the Mutant 1 and Mutant 2 alleles linked on the same chromosome? If you believe the two mutant alleles are linked, then calculate the genetic distance between the two genes.

**Answer**