

Fruit Fly Exercise 9

Goal

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. Identify the phenotype of a fruit fly within StarGenetics.
2. Determine whether a phenotype is dominant or recessive relative to another phenotype through the analysis of results from genetic crosses.
3. Use Punnett Squares to predict and confirm expected genotypic and phenotypic ratios.
4. Analyze experimental results to determine a trait's mode of inheritance.
5. Design genetic crosses and analyze experimental results to determine whether mutations are in the same or different genes.

Getting started with StarGenetics

- To get to StarGenetics, please navigate to: <http://star.mit.edu/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 allele in the Mutant 1 fly confers a dominant or recessive phenotype.

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?

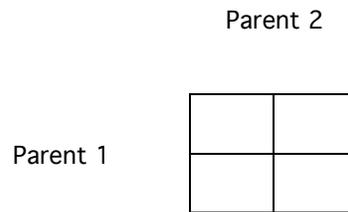
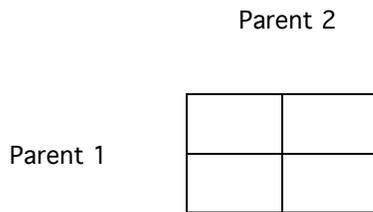
Answer

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 the mutations, which result in the same phenotype, are in the same gene or different genes.

- a) A simple complementation test will allow you to determine whether the Mutant 1 and Mutant 2 mutations are in the same gene. Can you perform a complementation test to determine whether these two mutations are in the same gene or different genes? Why or Why not?

Answer

- b) Design a cross or set of crosses to determine whether the Mutant 1 and Mutant 2 alleles are in the same gene or different genes. 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

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

Note: The average length of a gene in *Drosophila melanogaster* is 11.3 kb (kilobase) and the largest gene is 100 kb. The recombination rate in *Drosophila melanogaster* is 3.3 cM / Mb (megabase).

Answer