Massachusetts Institute of Technology hhmi

StarGenetics

Name_____

Fruit Fly Exercise 2 – Level 2

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 Objectives

After completing this exercise, you will be able to:

1. Determine whether a phenotype is dominant or recessive relative to another phenotype through the analysis of results from genetic crosses.
2. Predict expected genotypic and phenotypic ratios that would result from a genetic cross when given two parent individuals.
3. Describe differences between observed and expected phenotypic ratios.
4. Generate and test an appropriate hypothesis to explain observed experimental results.
5. Determine whether mutations are in the same or different genes through the analysis of results from genetic crosses.
6. Design genetic crosses and analyze experimental results to distinguish between different modes of inheritance.
7. Generate a genetic map that specifies the map distances between alleles.

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** on the main menu.
- Click on the **Fruit Fly Exercise 2 – Level 2** file.

You have been working with *Drosophila melanogaster* flies. By now, you are familiar with wild-type flies and know that they have red eyes. In one of your fly vials, you discover a male fly with orange colored eyes. You are intrigued since you have never seen a fly with such an unusual eye color. You call this mutant "**Orangeye**". You decide to do some genetic analysis of this unusual mutant. To do this, you set up a cross between the **Orangeye** mutant and a wild-type female.

- Drag the **Orangeye** mutant and the wild-type female to the **Mating site**.
- Click on the **Mate** button.

1 Describe the progeny that results from this cross.

- Each resulting offspring can be viewed by clicking on the **Individual** tab or a summary of the results is available in the **Summary** tab.

Answer

Number of flies that look like the wild-type parent: _____

Number of flies that look like the Orangeye parent: _____

Total number of progeny: _____

2 Based on these results, does the Orangeye mutant allele confer a phenotype that is dominant or recessive to wild type? How can you tell?

- You can use the **Punnett Square** tool to help decipher genotypes for a given trait.
- In the **Punnett Square** tool, click on the different genotypic options to see the resulting genotypic ratios.

Answer

3 You intended to separate the F1 males from the F1 females (from the cross in question 1, above) as soon as they emerged. Unfortunately, school closed due to a snowstorm and by the time you get back to your flies, you find that the F1 flies have emerged and mated! You decide to make the best of it and analyze the F2 progeny obtained from this cross. While you wait for the F2 larvae to mature into flies, you decide to predict what F2 progeny will result from this cross. Show your predictions below (before using StarGenetics to perform the cross) and indicate the genotypic and phenotypic ratios that you expect. Your predictions should be based on your answer to question 2.

Answer

4 Now go ahead and actually mate an F1 female to an F1 male.

- To start a new mating click on the **New experiment** button.
- Perform mating as previously described.

a) What results do you observe? Indicate the phenotypic ratios from this cross. Do the results match your predictions?

Answer

b) What hypothesis could explain the phenotypic ratios you observe for the F2 generation? Explain your reasoning and show your work.

Answer

5 You share your unusual results from question 4 with a friend who is also studying genetics in a *Drosophila* lab. She tells you that she has a fly strain with another mutant eye color, white. Your friend gives you a female fly, **Whiteye 1** from her true-breeding white-eyed fly stock. She also tells you that the Whiteye mutant allele confers a phenotype that is recessive to wild type.

a) Is the mutation that confers white eyes in the Whiteye 1 mutant found on the X-chromosome or on an autosomal chromosome? Set up a series of cross(es) that will allow you to answer this question. Explain the rationale behind these crosses and show their results.

Answer

b) Set up a cross between Orangeye and Whiteye 1. Based on the results you obtain, indicate whether the mutations in Whiteye 1 and Orangeye are in the same gene or in different genes. Explain your answers and show your work.

Answer

6 Your friend gives you two more homozygous true-breeding female flies from two different fly strains with white eye color that you name **Whiteye 2** and **Whiteye 3**. She tells you that based on the results you have obtained in question 4 she believes that one of the new white-eye fly strains has a mutation that is located on the same chromosome as the Orangeye mutation.

a) What is the mode of inheritance of the Whiteye 2 and Whiteye 3 mutant alleles? In your answer, be sure to specify whether the mutant alleles are located on the X-chromosome or on an autosome and also whether they confer phenotypes that are dominant or recessive to wild type. Set up crosses that will allow you to answer this question. Explain the rationale behind these crosses and show their results.

Answer

b) Are the Whiteye 2 and Whiteye 3 mutations located in the same gene as the Orangeye mutation? If either of the mutations is located in a different gene from Orangeye, then determine if the mutant allele(s) is linked or unlinked to the Orangeye gene. Set up crosses that will allow you to answer this question. Explain the rationale behind these crosses and show their results.

Answer

c) Integrate what you know about Whiteye 1, 2, and 3 and Orangeye to make a genetic map of the chromosome on which the Orangeye mutation is found. Please indicate any distances between genes when relevant. If any of the genes are found on a different chromosome, then indicate this as well.

Answer