

Fruit Fly Exercise 7 – 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. Identify the phenotype of a fruit fly within StarGenetics.
2. Determine whether mutations are in the same or different genes through the analysis of results from genetic crosses.
3. Determine whether a phenotype is dominant or recessive relative to another phenotype through the analysis of results from genetic crosses.
4. Design an experimental strategy to isolate organisms with a specific genotype.
5. Generate a genetic map that specifies the map distances between alleles.
6. Construct a linear genetic pathway that illustrates the relationships between 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** on the main menu.
- Click on the **Fruit Fly Exercise 7 – Level 2** file.

Fruit flies rely on their olfactory system to locate food, to find a mate, and to find the right place to lay their eggs. In fact, although fruit flies have brains smaller than a poppy seed, they are able to incorporate various types of visual and olfactory information to find food sources in a vast array of environments.

Fruit flies are able to differentiate among many different types of odors (they can be trained to avoid specific odors too!). In *Drosophila*, each antenna contains approximately 1200 olfactory neurons that help with the task of detecting and differentiating between various scents.

Fascinated by this fact, you decide to study the genetics of odor differentiation in fruit flies. You start with a fruit fly strain that has unusually large antennae. These flies were found on tropical islands in the Pacific and are known to feed on a wide range of fruits. These flies also avoid certain fruits that contain substances that are toxic to the flies. You hypothesize that the large antennae of these fruit flies might confer to them the ability to discriminate between the numerous edible and toxic fruits found on the Pacific islands.

To identify the genes that are important to large antennae development, you mutagenize wild-type flies to generate mutants with antennae defects. Via this process, you identify flies that have either shortened antennae or no antennae at all. In your **Strains** box in StarGenetics, you will find male (M) and female (F) flies for four mutant strains: **Mutant 1**, **Mutant 2**, **Mutant 3** and **Mutant 4**. In preliminary experiments, you observe that these mutant flies have a compromised “sense of smell”! You also find that each mutant fly contains a single mutation and is true breeding. You now need to perform further genetic analysis of these mutants.

- 1 Describe the phenotypes of Mutant 1, Mutant 2, Mutant 3 and Mutant 4.

Answer

2 Are the mutations in Mutant 1, Mutant 2, Mutant 3, and Mutant 4 in the same gene or in different genes? Describe the reason for all crosses performed to answer this question, their outcomes, and the conclusion that you drew from each of these crosses.

- You can set up a cross by dragging the specific parent flies to the **Mating site** and by clicking on the **Mate** button.
- Mating results can be seen on the **Summary** tab and each resulting offspring can be viewed by clicking on the **Individual** tab.
- To start a new mating experiment, click on the **New experiment** button. Your current experiment will automatically be saved for you. To keep track of your experiments, you can rename the experiment within the **Saved experiments** window.

Answer

3 From the results of some of your crosses, you suspect that some of the mutations are found in genes that are linked. You wish to determine which, if any, of these genes are linked. Identify which, if any, of these genes are linked and determine the map distances between linked genes. Describe the crosses that you did, their outcomes, and the conclusion that you drew from each of these crosses.

Note: for each of the linkage analyses you perform, you may need to generate the flies used in the test cross. Some double mutant strains have been provided to you for your analysis, but you may need to create additional strains to complete your analysis. In the Strains box in StarGenetics, double mutant strains are referred to by both mutations. For example, "1&2" means that the mutation in Strain 1 and the mutation in Strain 2 are both present in one double mutant strain, called "1&2".

Answer

4 Given that genes affected within these mutants are important for the specification of antennae length and odor differentiation in these species of fruit flies, you decide to determine if they can be rearranged into a linear pathway. Perform the sets of crosses needed to determine the linear order of function of all the genes you identified. Draw this pathway in the space provided below. Note that your pathway should include genes, not mutations. Be sure to specify if there are any ambiguities in the order of genes in your pathway and, if this applies, illustrate all of the possibilities. Describe the crosses that you did, their outcomes, and the conclusion that you drew from each of these crosses.

Note: Some double mutant strains have been provided to you for your analysis, but you may need to create additional double mutant strains to complete your analysis. In the Strains box in StarGenetics, double mutant strains are referred to by both mutations. For example, "1&2" means that the mutation in Strain 1 and the mutation in Strain 2 are both present in one double mutant strain, called "1&2".

Answer

