

AP Biology Lab 7: Genetics of *Drosophila* (virtual version)

Overview: Fruit flies—the genetic whipping boy. Fly genetics are a huge part of the field, the tiny little *Drosophila melanogaster* providing aspiring geneticists with over a century of good times. And flies can also be a royal pain in the butt to work with. Especially if you're new at it. So let's use the benefits of the modern age and perform our fly lab squarely within the boundaries of cyberspace. Ready? Good. Let's go.

Directions:

1. Sign in and log on to your computer. Open the internet browser and go to the following website: <http://www.sciencecourseware.org/vcise/drosophila/>
2. Click the “Enter as a Guest” option.
3. And here we are in our virtual lab. One very important thing: **DO NOT BACK OUT OF THIS PAGE UNTIL YOU ARE COMPLETELY DONE!!!** Or you will have to start over.
4. The first order of business: you will need to order your fruit flies. Click on the computer and use the “Order Flies” icon. We are going to perform three different crosses. For each one, you will need to order the correct flies:
 - a. Cross 1: Cross a sepia eyed male with a wild type (red eyed) female.
 - b. Cross 2: Cross a sepia eyed, normal wing male with a wild type eyes, vestigial wing female.
 - c. Cross 3: Cross a wild type male with a white eyed female.
5. After ordering your flies, you will have to work through the lab until you eventually have sorted your F1 progeny. Make sure you record all of the necessary data in your data table.
6. After you have recorded the data, you will need to establish a cross between members of your F1 generation. To do this, click on the piles of sorted flies to zoom in. Then click the “Use in New Mating” button. Do this for both a male and a female. Then return to your lab. Click on the mating jar.
7. Sort your progeny and record the necessary data in the F2 data table.
8. Now that you have the F2 data, you can begin to formulate some hypotheses about the mode of inheritance for the traits you are looking at. Briefly comment on what you believe the mode of inheritance to be. Address the following points in your conclusion:
 - a. What is the approximate phenotypic ratio shown in the F2 generation?
 - b. Does the gender of the flies seem to affect the inheritance of the traits in the cross?
 - c. Propose a hypothetical mode of inheritance for your given traits.
 - d. Use the planner page that follows the data page to develop explain your hypothesis.
 - e. Use chi-square analysis to determine the p-value for your hypothesis, and justify your hypothesis.
9. After you collect F2 data, clean out your incubator by clicking on the small trash can next to it. This resets your lab for the next cross.
10. Congratulations. Do this for each of your crosses. To order new flies, simply click on the computer and repeat
11. Following the three crosses that you are required to do, conduct a fourth dihybrid cross of your choosing, that looks at the mode of inheritance of two new traits.

Chi- Square Analysis

Directions: Using a Chi-Square test, determine whether or not the variation between the observed and expected number of individuals of each phenotype can adequately be explained by chance alone. Use the following formula and apply it to the chi-square table to determine the confidence level for the hypothesis that the variation you observed is due solely to chance. The table of probabilities is provided below the formula. The table is “upside-down” compared to the normal probability table, degrees of freedom are listed going across on the top row and probabilities are listed going down the first column.

Remember, any probability greater than .05 is not unlikely enough to disprove your hypothesis.

$$\chi^2 = \sum \frac{(o-e)^2}{e}$$

where

χ^2 is Chi-squared,
 Σ stands for summation,
o is the observed values, and
e is the expected values.

| CHI-SQUARE TABLE | | | | | | | | |
|--------------------|------|------|-------|-------|-------|-------|-------|-------|
| Degrees of Freedom | | | | | | | | |
| p | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| 0.05 | 3.84 | 5.99 | 7.82 | 9.49 | 11.07 | 12.59 | 14.07 | 15.51 |
| 0.01 | 6.64 | 9.32 | 11.34 | 13.28 | 15.09 | 16.81 | 18.48 | 20.09 |

Cross 1: P= sepia male * wild type female

Data Table 1- Phenotypes & numbers of the F1 progeny classes

Data Table 2- Phenotypes & numbers of the F2 progeny classes

Hypothesized Inheritance Pattern:

Hypothesis Justification & Testing

Cross 1:

1. Symbolically represent your parental cross.
2. Draw a Punnett square to show the possible allelic combinations for this gene in the F1 generation (note, all parental generation flies are homozygous for selected traits when possible). You do not need to keep track of gender unless you believe it is a factor in this cross.
3. Identify the genotype, phenotype and ratios (for each) that the F1 flies should exhibit.
4. Symbolically represent the F1 cross that you performed.
5. Draw a Punnett square to show all the allelic combinations possible in the F2 generation.
6. Identify the genotype, phenotype and ratios (for each) that the F2 flies should exhibit.
7. Compare your F2 experimental results to the predicted ratios, using chi-square analysis.
8. Identify the cross you performed as the following: Monohybrid or Dihybrid, and identify the traits as Autosomal or Sex-Linked, Dominant or recessive mutations.
9. Justify your conclusion using your chi-square analysis.

Cross 2: P= sepia-eye, normal-wing male * wild type, vestigial wing female

Data Table 1- Phenotypes & numbers of the F1 progeny classes

Data Table 2- Phenotypes & numbers of the F2 progeny classes

Hypothesized Inheritance Pattern:

Hypothesis Justification & Testing

Cross 2:

1. Symbolically represent your parental cross.
2. Draw a Punnett square to show the possible allelic combinations for this gene in the F1 generation (note, all parental generation flies are homozygous for selected traits when possible). You do not need to keep track of gender unless you believe it is a factor in this cross.
3. Identify the genotype, phenotype and ratios (for each) that the F1 flies should exhibit.
4. Symbolically represent the F1 cross that you performed.
5. Draw a Punnett square to show all the allelic combinations possible in the F2 generation.
6. Identify the genotype, phenotype and ratios (for each) that the F2 flies should exhibit.
7. Compare your F2 experimental results to the predicted ratios, using chi-square analysis.
8. Identify the cross you performed as the following: Monohybrid or Dihybrid, and identify the traits as Autosomal or Sex-Linked, Dominant or recessive mutations.
9. Justify your conclusion using your chi-square analysis.

Cross 3: P= wild type male * white-eyed female

Data Table 1- Phenotypes & numbers of the F1 progeny classes

Data Table 2- Phenotypes & numbers of the F1 progeny classes

Hypothesized Inheritance Pattern:

Hypothesis Justification & Testing

Cross 3:

1. Symbolically represent your parental cross.
2. Draw a Punnett square to show the possible allelic combinations for this gene in the F1 generation (note, all parental generation flies are homozygous for selected traits when possible). You do not need to keep track of gender unless you believe it is a factor in this cross.
3. Identify the genotype, phenotype and ratios (for each) that the F1 flies should exhibit.
4. Symbolically represent the F1 cross that you performed.
5. Draw a Punnett square to show all the allelic combinations possible in the F2 generation.
6. Identify the genotype, phenotype and ratios (for each) that the F2 flies should exhibit.
7. Compare your F2 experimental results to the predicted ratios, using chi-square analysis.
8. Identify the cross you performed as the following: Monohybrid or Dihybrid, and identify the traits as Autosomal or Sex-Linked, Dominant or recessive mutations.
9. Justify your conclusion using your chi-square analysis.

Cross 4: Student-designed cross. Indicate parental phenotypes:

Data Table 1- Phenotypes & numbers of the F1 progeny classes

Data Table 2- Phenotypes & numbers of the F1 progeny classes

Hypothesized Inheritance Pattern:

Hypothesis Justification & Testing

Cross 4:

1. Symbolically represent your parental cross.
2. Draw a Punnett square to show the possible allelic combinations for this gene in the F1 generation (note, all parental generation flies are homozygous for selected traits when possible). You do not need to keep track of gender unless you believe it is a factor in this cross.
3. Identify the genotype, phenotype and ratios (for each) that the F1 flies should exhibit.
4. Symbolically represent the F1 cross that you performed.
5. Draw a Punnett square to show all the allelic combinations possible in the F2 generation.
6. Identify the genotype, phenotype and ratios (for each) that the F2 flies should exhibit.
7. Compare your F2 experimental results to the predicted ratios, using chi-square analysis.
8. Identify the cross you performed as the following: Monohybrid or Dihybrid, and identify the traits as Autosomal or Sex-Linked, Dominant or recessive mutations.
9. Justify your conclusion using your chi-square analysis.