Topic 5c: Genetics – Fruit Fly Experiment

Resources:


http://www.carolina.com/product/living+organisms/animals/animal+food/drosophila,+fruit+fly+culture+kit,+nongenetic+use.do

Building on:
Cell parts and functions
Chromosomes
Mitosis and meiosis

Links to Chemistry:
DNA chemistry

Links to Math:
Ratios
Percentages
Probability

Stories:
Since the turn of the 19th Century, biology students have used fruit flies (*Drosophila melanogaster*) as a way to study Mendelian genetics relatively quickly and easily. The good news is that we no longer use ether, a vintage World War I anesthesia, that would render the fruit flies and sometimes their handlers unconscious! Rotten bananas have been replaced as a food source for the larvae by much more benign (and starchy) media.

Lab Instructions and Materials for the Teacher:
This is a very involved, detail-oriented lab that should be attempted only with higher-level students. If the students try to “cookbook” the lab each day, they will find themselves lost in a labyrinth of procedures and unable to grasp the “big picture.” This may not become apparent until they try to write the lab up at the end of four to six weeks of data collection!

You should order flies about one month prior to the experiment so that you can super-culture the flies that you order. Start the project while studying mitosis and meiosis so that F₁ results will start to be obtained as you study Mendelian genetics in the textbook. You can also order pre-crossed F₁ flies and perform a single generation F₂ cross.

When choosing flies, make sure that the traits crossed occur on separate chromosomes (fruit flies have only four pair); otherwise, the results will not turn out “Mendelian,” but rather they are “linked.” This has been done for you on the sheet below, but you can check the chromosome number when ordering.
The project overview can be seen as follows:

4-6 male fruit flies of one type x 2-4 virgin female fruit flies of a different type = \( P_1 \)  

[breed with]  

[Allow two weeks.]  

Use 10 or so \( F_1 \) for \( P_2 \) in a separate vial.  

[Obtain] 100 + offspring = \( F_1 \)  

4-6 males x 4-6 females = \( P_2 \)  

[allow 2 weeks]  

[Obtain] 100 + offspring = \( F_2 \)

The first vial is called the \( P_1 F_1 \) vial and the second is a \( P_2 F_2 \) vial. It takes about two weeks for adult flies to mate and obtain offspring, so the project should take from four to six weeks total. More information is available from Carolina Biological Supply Company. When ordering the stock flies from them, they will send you a *Drosophila* information manual.
How to make an FF vial:

1. Rinse your vial with warm water—NO SOAP! Dry it out with a paper towel, but be careful not to touch the inside of your vial with your finger!
2. Add one level capful of FF Medium (food) to the vial.
3. Gather one capful of cool water, a glass stirring rod and your vial with food.
4. Add the capful of water to the vial with food; POKE AND TAP for 5 SECONDS (no longer!) with the stirring rod. Tap on tabletop to settle contents.
5. Let vial set up for one minute.
6. Add 10-12 grains of yeast; spread them around on the food.
7. Wipe down the inside of the vial with a paper towel (again do not touch the sides with your finger); be careful not to touch the food.
8. Add a foam cap.
9. Label with:

<table>
<thead>
<tr>
<th>JC + MJ</th>
<th>5/6</th>
<th>eb x ey</th>
<th>11/20</th>
</tr>
</thead>
<tbody>
<tr>
<td>Your and your partner’s initials</td>
<td>Your class period</td>
<td>Your cross male x female</td>
<td>Date started (both male and female added)</td>
</tr>
</tbody>
</table>

Napping and Sorting:

1. Have materials ready: FF vial, wand, FlyNap, textbook, white paper, index cards, stereo microscope, paint brush
2. Slide the foam cap on the FF vial as high as possible so that flies do not escape. (We’re trying to minimize the amount of FlyNap that hits the foam cap).
3. Dip wand into FlyNap. Press the wand tip against the side of the bottle to remove the excess. (It should not be “dripping wet.”)
4. QUICKLY!!:
   - Tap the FF vial on the counter several times.
   - Press the foam cap in slightly.
   - Insert the FlyNap loaded wand into the vial past the foam cap.
   - Release the foam cap to trap the metal part of the wand against the side of the FF vial.
5. Place the FF vial ON ITS SIDE in an open textbook. 
   *Do NOT leave the FF vial upright. (The flies will fall into the food and get stuck!!)*
6. Observe the vial carefully! When all flies have stopped moving, wait another 30 seconds, then dump them onto plain white paper.
7. Cover your napped flies on the paper with a Petri dish (keeps flies that may wake up contained).
8. Use paint brush (static electricity method) to move flies around.
9. Use an index card to observe flies under a STEREO MICROSCOPE. Sort into desired piles / vials / counts.
10. If flies are F1 or F2 to be counted, push into piles by trait (eb, vg, + . . .) and have your teacher SIGN-OFF on your results. (Put all results in your logs.)
11. DISCARD unwanted flies down the sink with lots of water; please keep flies from waking up and flying around the classroom!
HONORS BIOLOGY: FRUIT FLY CROSS CHOICES

MONOHYBRID CROSSES:

_____  Wild (+)  X  Vestigial (vg) - female vg only
_____  Wild (+)  X  Ebony (eb)
_____  Wild (+)  X  Eyeless (ey)

DIHYBRID CROSSES:

_____  Eyeless  X  Vestigial (female)
_____  Ebony  X  Vestigial (female)
_____  Ebony  X  Eyeless

SEX-LINKED CROSS:

_____  Wild  X  White Eye (male)
_____  Wild  X  White Eye (female)

SEX-LINKED AND DIHYBRID:

_____  Eyeless  X  White Eye (male)
_____  Eyeless  X  White Eye (female)
_____  Ebony  X  White Eye (male)
_____  Ebony  X  White Eye (female)
_____  Vestigial (female)  X  White Eye (male)
1. Title: List a cool title! *Drosophila melanogaster* is the scientific name of FFs.

2. Purpose: State, in your own words, the reason for this study and paper. Make sure and include the cross you have chosen.

3. Procedures: List the basic procedures, in step-by-step fashion, required to perform this lab. Don’t get bogged down here; just list simple, shorthand procedures like “nap flies,” but include enough so that the entire lab is outlined.

4. Data (Log of P1/F1 and a separate Log of P2/F2): Please turn in the logs from your Fruit Fly Info packet. *I will already have checked these.*

5. Predictions: Please turn in the Predictions page from your Fruit Fly Info packet. *I will already have checked these.*

6. Results/Actuals: This is an organized presentation of your two months of counting and determining the traits for two generations of offspring! Include a well-organized chart of the number of flies you got of each phenotype; give a total of each of these phenotypes at the bottom of this chart. *Again, show the data which I signed off on.*

   Following this chart, you should clearly give four ratios:

   Raw Ratio:
   Reduced Ratio:
   Closest Mendelian Ratio (to the reduced):
   Your $F_1$ Prediction Ratio:

   *Repeat* the chart and the four ratios for your $F_2$ actuals.

   You will be graded on the accuracy of your results and I can tell when you're lying!!

7. Conclusion: THE MOST IMPORTANT PART OF YOUR REPORT!!! This is when you explain to the reader what the “link” is between your predicted and actual ratios—right or wrong!! Start by summarizing your procedures and results! If all worked out correctly, then you need to discuss the mechanisms of basic Mendelian genetics that caused these occurrences. If all went wrong (or parts of the lab did), you need to discuss and show with more Punnett squares your analysis of why you got what you got! Don’t be alarmed if your actuals are wrong; some of my best and highest scored
papers have had incorrect results, **BUT** the students explained and illustrated the possible explanations for the errors. These have been some of my best papers because students had to research and really “think genetics” to explain who *really* mated with whom; remember, the flies tell the truth!
# Fruit Fly Lab Write-up

## Grade Sheet

<table>
<thead>
<tr>
<th>Title</th>
<th>Purpose</th>
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<tbody>
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## Procedures

- Logs (already √'d, but include here)
- Predictions (already √'d, but include here)
  
## Results

- Your own? (You lose 5 points for each set borrowed F₁ / F₂.)
- Signed off by teacher?
- Accurate (“Good data”)?
- Four ratios calculated correctly (F₁ and F₂)?

## Conclusion

- Summarizes procedures and results?
- Discusses basic genetics?
- Discusses genetics specific to your cross (sex-linked, dihybrid)?
- Explains differences between predictions and results?
- Reasonable error analysis / best conclusions possible are drawn?
- Intelligently handles data and data analysis?

## Total

\[ \text{TOTAL} = \]