

GENETICS AND EVOLUTION

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Biology Lab III

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*Every honest researcher I know admits he's just a professional amateur.
He's doing whatever he's doing for the first time. That makes him an
amateur. He has sense enough to know that he's going to have a lot of
trouble, so that makes him a professional.*

— Charles F. Kettering (1876-1958) (Holder of 186 patents)

ACKNOWLEDGEMENTS

I express my sincere gratitude to our instructors, Dr. N. G. Prasad and Dr. Rajesh Ramachandran, for not only describing the experiments and their science in depth, but also for teaching us the art of observing, that of performing experiments, so we can appreciate the intellect behind the procedures, rather than mindlessly following them.

I also thank Vivek Sagar (MS11017) for his contribution to this report as my lab-partner, who made the task of performing experiments immensely comfortable and productive at the same time.

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Part I

EXPERIMENTS

INTRODUCTORY SESSION

1.1 OBJECTIVE

To learn the art of observation and thereby analyse the morphological features of the wild type and mutant *Drosophila melanogaster*.

1.2 THEORY

1.2.1 Morphology

Morphology is the study of form and structure of organisms.

Drosophila melanogaster is a small fly. It has two red coloured compound eyes, made up of 700-800 hexagonal units. It has two translucent wings, and a pair of halteres. It has a hairy body. It also has a pair of antennae. The abdomen is striped with visible differences between males and females.

1.2.2 Life Cycle

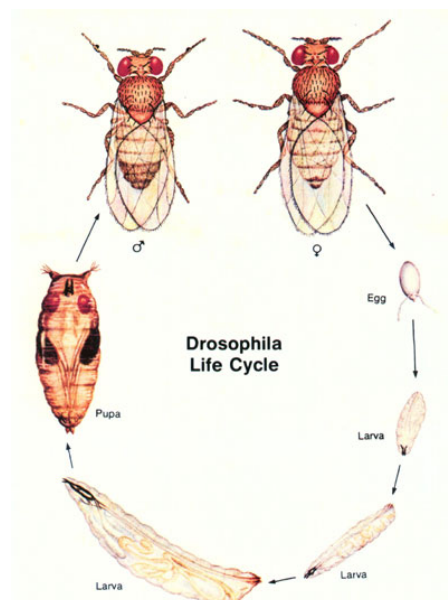


Figure 1: *Drosophila* Life Cycle [?]

1. Embryo: The first stage is from the fertilization of the egg, till the embryo hatches (under ideal conditions (at 25 °C), takes 12-

16 hours), inside the mother. The insect starts as a single cell, and then develops into the larval form before it hatches.

2. Larva: The second stage is from birth until the larva pupates. This stage is generally worm-like. It grows for about 4 days while *molting* twice (into 2nd- and 3rd-instar larvae), at about 24 and 48 h after hatching. They feed on the micro-organisms that decompose the fruit, as well as on the sugar of the fruit itself, during this period.
3. Pupa: this is the third stage, from pupation till eclosion. This stage is marked by reduced movement and often sealed with a cocoon. The metamorphosis takes about 4 days.
4. Imago: In this stage, the holometabolous insects are adults and usually have wings and functioning reproductive organs.



Holometabolism:
This term is used to describe the specific kind of insect development which includes all four life stages.

Holometabolic development gives the offspring a very unique advantage of not being forced to compete with the adults since they inhabit different ecological niches due to the morphological differences in the different stages of their life cycle.

1.2.3 Difference between Males and Females

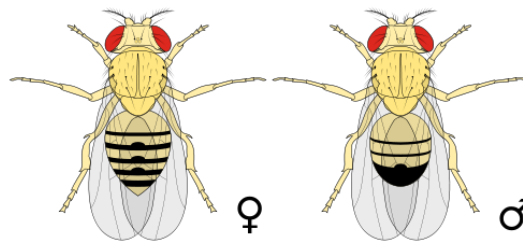


Figure 2: Male and Female *Drosophila*

1. Females have a shorter life compared to males.
2. On an average, females are larger than males (although not necessarily individually true)
3. Males have a larger portion of their back black compared to females. However, this distinction is not very clear until they're mature.
4. Males have sex-comb which is the most reliable distinguishing feature amongst males and females. It is present in the first leg.

1.3 EXPERIMENT

We were divided into groups of three and each group was given a vial containing over 30 *Drosophila melanogaster*. Our objective was to analyse them under a stereo microscope and study their morphology within 45 minutes.

My team consisted of Vivek Sagar (MS11017), Biplob Nandy (MS11004) and I (MS11003). The issue at hand was to focus a moving organism with the microscope. We came up with the following solution.

- A. Locate a cylindrical object with a small diameter.
- B. Use the object to push the cotton away from the walls of the container, while gradually moving into the container.
- C. Continue the process till a fly gets into the gap between cotton and the vial wall, upon occurrence of which, release the cotton to firmly hold the fly.
- D. This ensures that the fly has very restricted movements and is still alive.

This was followed by a discussion about the observations, after which we were told how to put the flies to “sleep”, or more precisely, anaesthetising them. The method was straight forward. It involved the use of ether, which inhibits neurological pathways in *drosophila*. The protocol followed was:

- A. Locate a funnel. At the terminal part of its conical region, attach a cotton ring.
- B. Add a few drops of the anaesthesia to the cotton.
- C. Now take an empty vial and place the funnel on its mouth, covering it completely.
- D. Locate the vial which contains the *drosophila* desired to be anaesthetised.
- E. Remove the cotton plug and instantly place the mouth of the vial on the funnel
- F. The *drosophila* will fall through the funnel into the empty vial, unconscious.
- G. Remove the funnel after a suitable duration.

One such unconscious fly's front leg was taken and focussed under a high power microscope and observed.

And lastly, Mutants were setup for viewing under stereo microscopes and we were asked to observe them.



After the flies recover their consciousness, their behaviour ceases to be normal.

1.4 OBSERVATIONS

1.4.1 *Coarse Focus*

1. Flies were of different size.
2. There were 3 pairs of legs.
3. All of them had Red coloured eyes.
4. All had their abdomen striped with Yellow Brown and Black
5. In most, there were 5 stripes.

1.4.2 *Fine Focus*

Observations of a particular fly

1. 2 hair like protrusions from the head were observed. Most likely they were antennae.
2. There were only 2 pairs of wings.
3. Back colour was Yellowish Brown
4. The body was shiny and globular.

Observations of a different fly

1. Hair like projections were visible on all three legs.
2. Abdomen was white in colour.
3. Halteres were observed.

Observations of yet another fly

1. Most of the body had black coloured hair, including the face.
2. Legs had a hook like structure
3. It seemed to be releasing a black shiny liquid
4. Lines in the wings were distinctly visible (later told to be wings)
5. Hexagonal eyes were visible. Could see the hexagonal elements.
6. Could see a slightly darker circle in the eye (later told to be sensory nerves)

Non-microscopic Observations

1. The flies try to run *away* from gravity.
2. The flies run *towards* light.

1.4.3 *High Power Microscope*

The sex comb was explicitly visible in the front leg.

1.4.4 *Mutants*

1. Barred eyes
2. Eye Colour
 - a) White
 - b) Orange
 - c) Brown
3. Curly Wings
4. Gray and Yellow Body

1.5 ACKNOWLEDGEMENTS

I thank both my team members, Biplob Nandy (MS11004) and Vivek Sagar (MS11017) for their contribution to the performance of the experiment.

Part II

THE SHOWCASE

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COLOPHON

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