

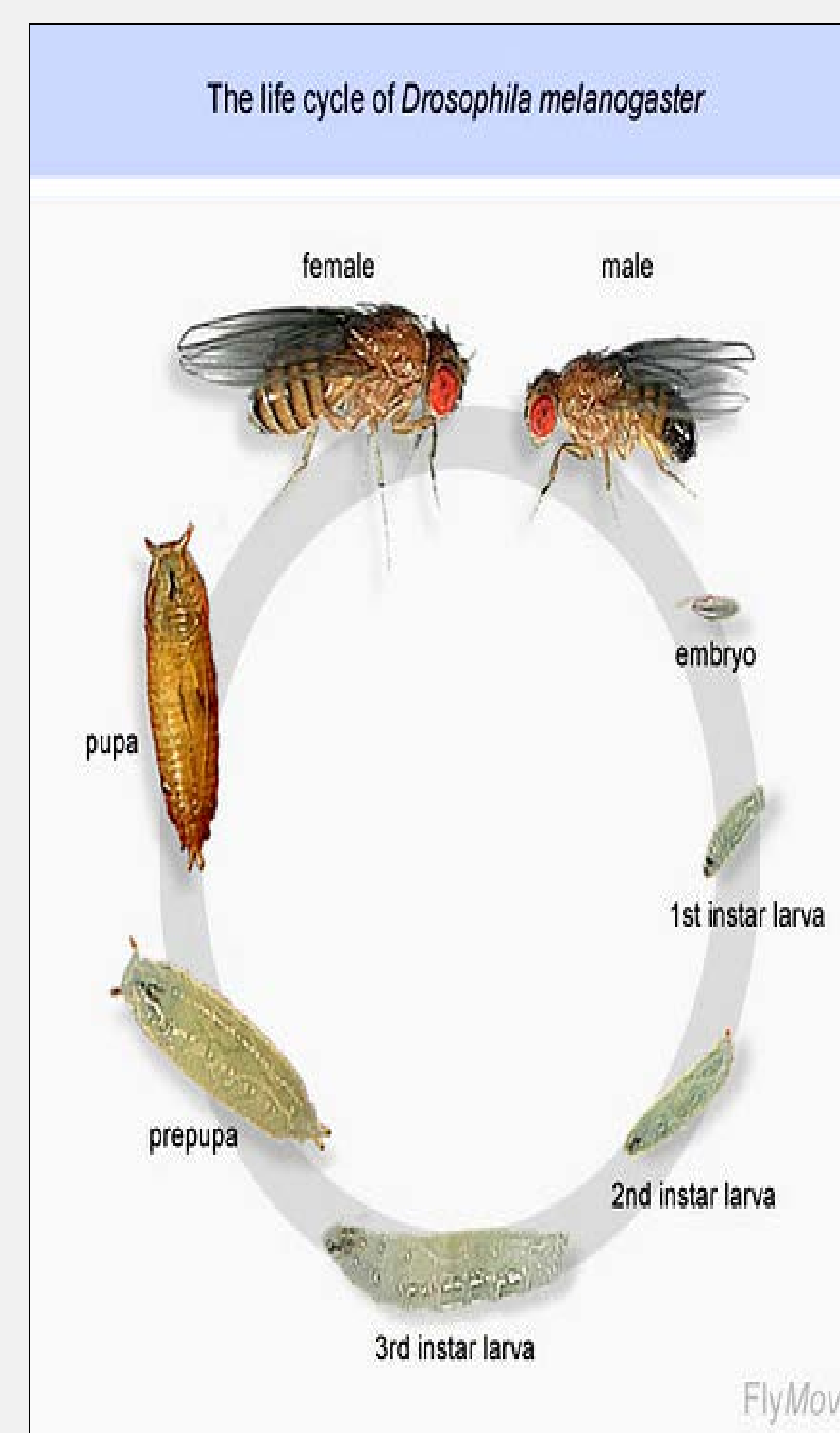
### Abstract

The development of interdisciplinary lessons and lab experiences that are suitable for use in the Living Environment classroom and laboratory was the primary goal of this ISEP summer research experience. Laboratory techniques such as DNA extraction, preparation of DNA for gel electrophoresis, as well as dissection and preparation of polytene chromosomes were practiced. Stocks of several strains of *Drosophila melanogaster* were procured and maintained for future use in the classroom. The Dino-Lite fluorescent digital microscope was utilized to view live displays of genetically modified organisms, specifically the GFP strain of fruit flies and fruit fly 3<sup>rd</sup> instar larva. Through the use of interactive and engaging lab exercises, the ideal outcome of the project is to hook the curious minds of students - enough so that they decide to delve into the STEM way of learning.

### Why the Fly?

Model Organisms are studied by many different researchers so they can compare their results and determine scientific principles that apply more broadly to other species. Ex: *Drosophila melanogaster*, *E. Coli*, *Danio rerio* (zebra-fish), *Mus Musculus* (mouse), *Arabidopsis thaliana* etc.

We limited our work to fruit flies so we can more easily unravel the genetic mechanisms that govern the traits of only one strain. Furthermore, the genes found in *Drosophila* function in a similar way to those found in humans. The genetic studies are divided into three areas, - Transmission, Molecular and Population Genetics. The studies within molecular genetics interface with other disciplines such as biochemistry, biophysics and cell biology.



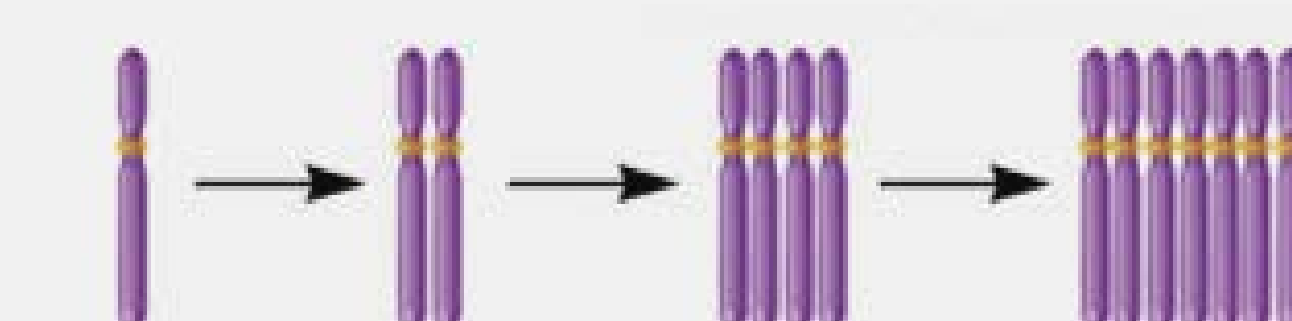
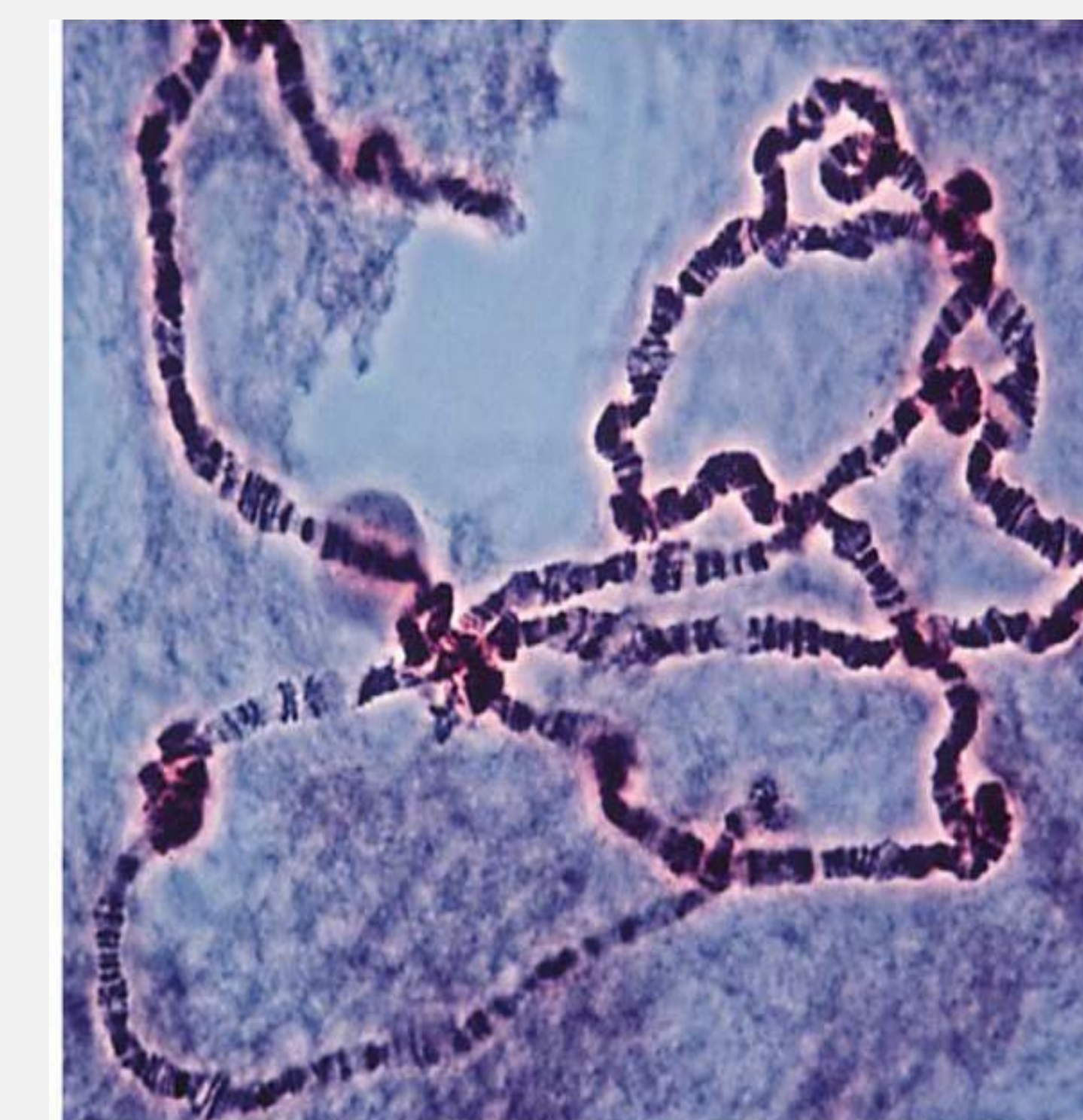
### Polytene Chromosomes

The morphology of polytene chromosomes provide a unique opportunity to study chromosome structure and gene organization.

### Salivary Gland Extraction & Polytene Squash

Procedure:

1. Obtain a third instar larvae and place in several drops of Phosphate Buffer Solution.
2. Isolate a pair of salivary glands by dissecting out mouth hooks with a pair of forceps.
3. Fix in 45% HOAc for five minutes.
4. Remove HOAc with pasteur pipette and repeat step 3 & 4.
5. Stain with Aceto-Orcein stain for twenty minutes.
6. Remove stain and wash with 45% HOAc. Wash glands 2x. Remove and discard HOAc with each successive wash.
7. Lower cover slip carefully over glands.
8. Squash the chromosomes by first covering the cover slip with tissue paper and then apply pressure with the ball of your thumb. Do not smear by moving the cover slip.
9. Examine the chromosomes under a light microscope, first at 400x and then at 1000x magnification using oil immersion.
10. To preserve - Seal the edges of the cover slip with nail polish. Label & Date.

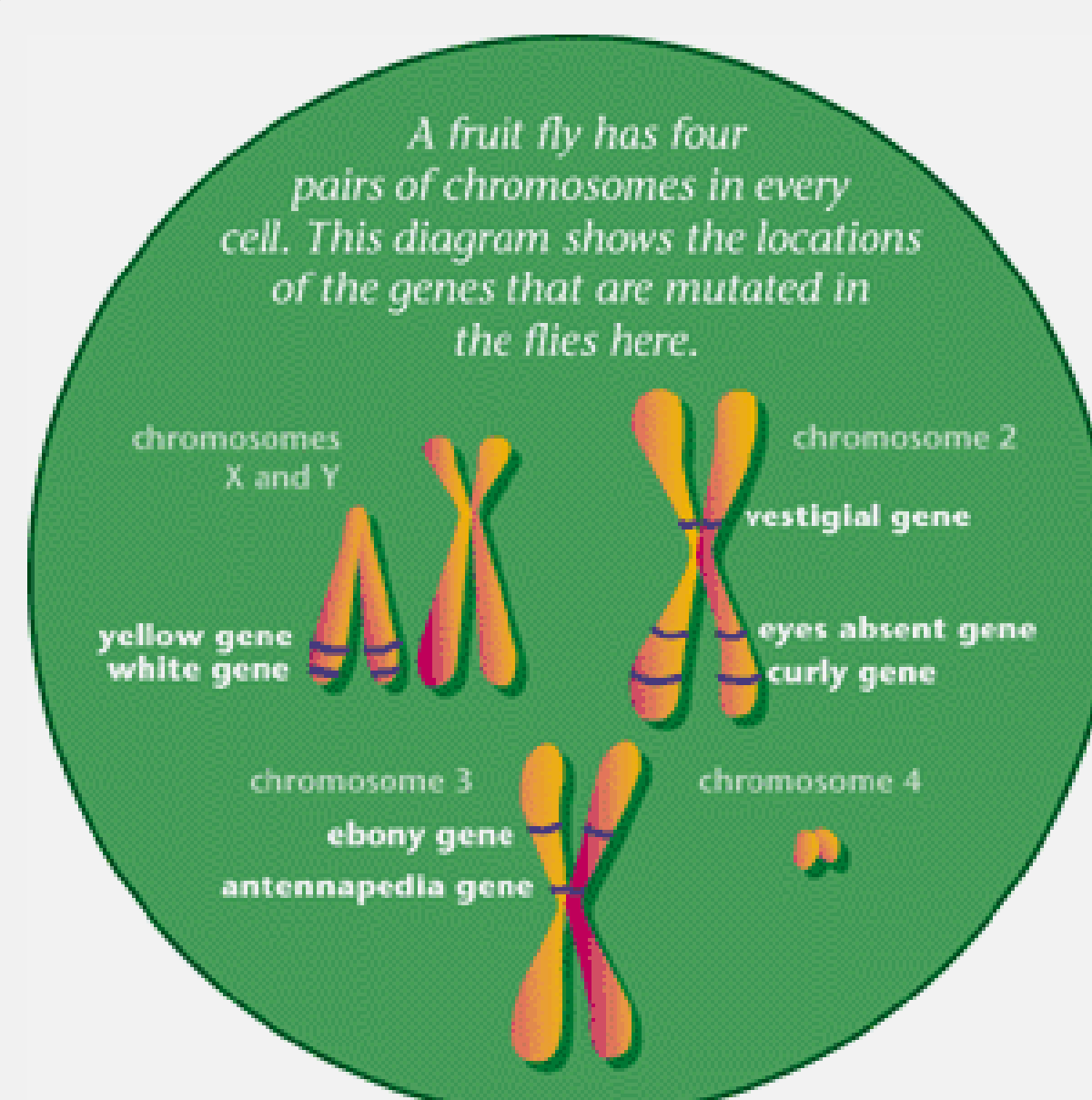


Each polytene arm is composed of hundreds of sister chromatids aligned side by side.

### Current Research

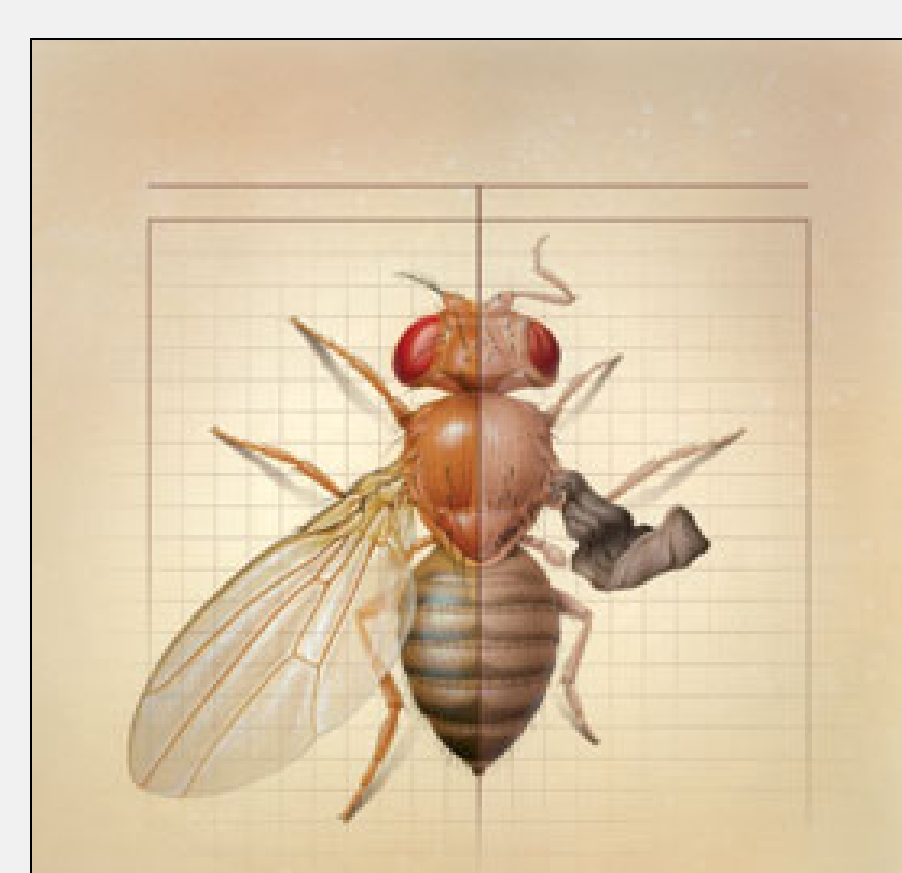
Part of the research we conduct is directly related to examining the relationship between the transmission of genes from parents to offspring and observing the outcome of the offspring's traits. Our understanding of transmission genetics was made conceivable through the work of Gregor Mendel as a result of his conceptual framework for genes and inheritance.

The simplest way that we approach this in the lab, is by employing a technique that examines the progeny of man-made constructed Genetic Crosses.



By isolating a single mutant offspring, the team working in Dr. Singh's lab was able to proliferate the mutant while guarding the mutation by using "Balancing techniques" often used in transmission genetics.

The next step was to use Molecular genetics to examine the specific characteristics of the mutation.



Suppressor of levy, as it is called in the lab, is being analyzed and surveyed for its molecular function using techniques pioneered in the field of Molecular Genetics

By employing the techniques mentioned above and others such as real-time PCR and Sanger Sequencing, we are able to characterize the molecular features of the mutant DNA isolated from a clone of the very first mutant containing -Su(levy)levy.

### Visualization of Genetically Modified Organisms (GMOs)



### Implementation

As a part of the Living Environment curriculum, students are expected to attain science literacy, generate explanations, exhibit creative problem solving and make informed decisions. The development of labs, demonstrations and lessons based on the ISEP summer research experience will assist teachers in implementing the process standards and content bands aligned to the NYS curriculum.

DNA Extraction: Students will be able to demonstrate their knowledge of the scientific method by developing an experiment that tests the amounts of DNA in various fruits.

Maintaining Stocks & Developing Crosses: Students will be able to observe the development and physical characteristics of *Drosophila* as well as to make connections between populations, organisms, cells, chromosomes, genes and DNA.

Polytene Chromosome Squash: Students will use tools and instruments for observing, measuring, and manipulating scientific equipment and materials and will analyze the nature of the relationships between structures and functions in living cells.

### Goals of ISEP

- ✓ To translate research and mentoring into science & engineering Education in urban Public Schools.
- ✓ Improve inquiry based laboratory experiences by developing hands on materials for use and demonstration.
- ✓ Track students during the pivotal transition from middle school to high school.

### Acknowledgements

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### References

Brooker, Robert J. *Genetics: Analysis & Principles*. New York: McGraw-Hill, 2012. Print.