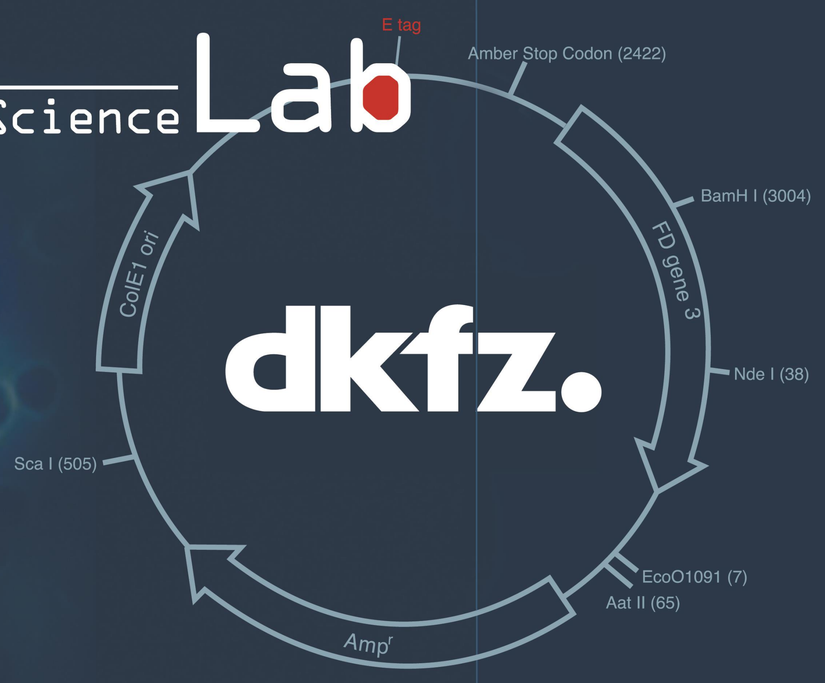
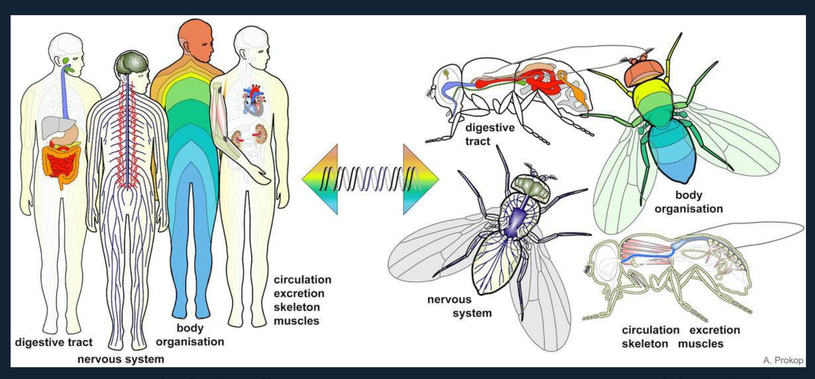
Heidelberger Life-Science Lab



Genetics and Drosophila AG

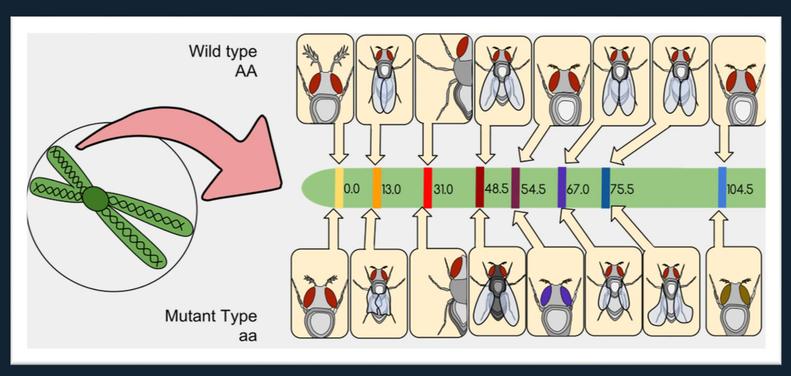
Did you know that half of everything we've learned about genetics so far is thanks to one small insect – the common fruit fly (die Fruchtfliege), lat. *Drosophila melanogaster*? We owe this model organism a great debt already, and its importance in basic research happening today is still just as strong. After all, *Drosophila* is in the very logo of the Life Science Lab for a reason!

Even though it's a small invertebrate, as different from a human as an animal can be, 60% of the fruit fly's genome carries the same genes that our genome does. Many of its organ systems are also similar enough to ours that we can use it to study such things as cancer and genetic mutations which are important for human health and medical research down the line.



Human and fruit fly organ systems are remarcably similar *(Source: Andreas Prokop, University of Manchester)*

Drosophila is a perfect model organism to learn the basics of Mendelian genetics, dominant and recessive gene traits and the connection between genes and protein function. What makes the fruit fly even better for research, however, is that is perfect for many advanced genetic techniques as well, such as visualizing proteins in tissues, screening the whole genome for protein function and genome editing using CRISPR.



In this AG, we will learn the basics of working with *Drosophila melanogaster* in a laboratory setting, including:

- handling flies by studying their physical characteristics, setting crosses and studying organs by dissecting flies at different life stages.

Physical characteristics are tied to gene function - wing shape and eye color are used as markers for genes and balancer chromosomes *(Source: Joe Jimbo)*

We will learn basic genetic techniques and how this knowledge is useful in fruit fly research, including:

- the Gal4/UAS system of gene over-expression, CRISPR system for mutagenesis, and RNA interference for protein depletion.

This year, we will use this knowledge to study neurobiology and behavior in the fruit fly. We will learn about the brain on a molecular as well as functional level, including:

- how does the brain regulate fly movement and decisions regarding whether to stay or to go when threatened
- what role the brain plays in fly mating and sexual behavior such as the mating dance or choosing a mate
- how does the brain interact with other organs such as the digestive system and why is the olfactory system important in decisions regarding feeding and nutrition
- how can we use Drosophila to study human brain disorders like Alzheimer's and Parkinson's diseases or cancer

Fruit fly was used to establish the first gene map, determining the location of genes and their degree of recombination in sexual reproduction *(Source: Wikipedia, Gene mapping)*

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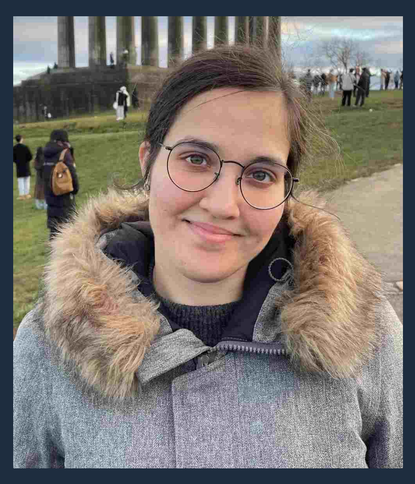

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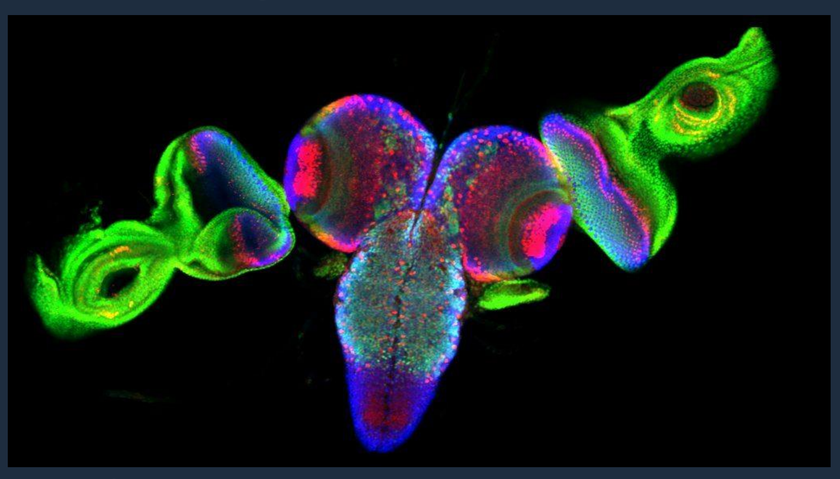
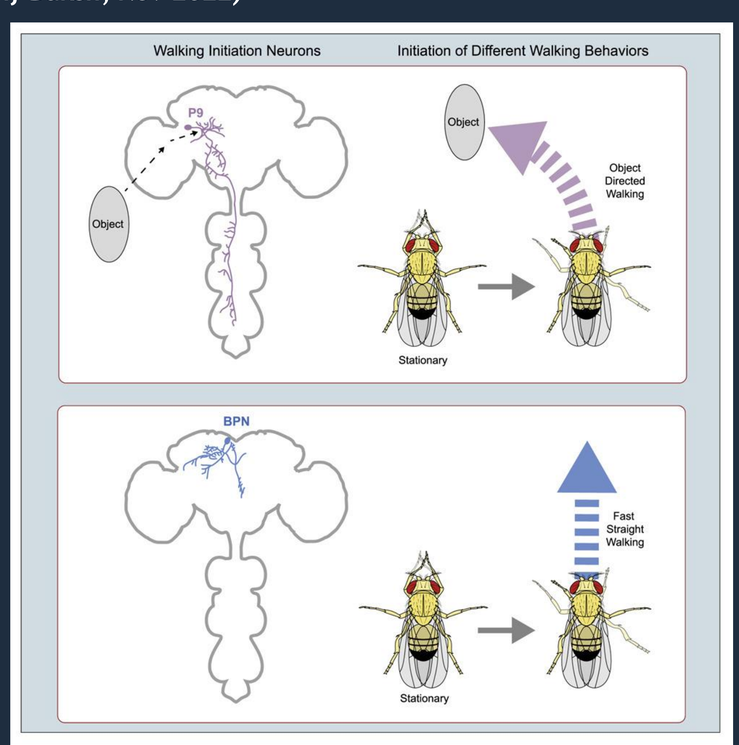


Drosophila melanogaster **has a large brain for its size at all stages of development. 40% of the fruit fly brain is devoted to processing input from the eyes. In this picture, larval brain is shown (central structure) with two optic lobes and the brain stem, as well as eye-antennal discs (green side structures), which will form the eyes and antennae of the adult fly.** ***(Source: NeuroArt Image Contest, image by Asif Baksh, Nov 2022)***



We can study the connection between behavior and neurology by giving flies special cues (visual or olfactory) and observing not just what they do, but also which neurons in the brain get turned on. Neurons are the cells in the brain required for the brain to receive messages from organs like eyes or proboscis, or send messages to the muscles on how to move. ***(Source: Bidaye et al, 2020)***