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G009 - The larval standard brain: The reconstruction of the larval memory center at cellular and synaptic resolution

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Brains organize behavior. This involves the integration of present sensory input, past experience, and options for future behavior. The insect mushroom body is a paradigmatic case of a central brain structure bringing about such triadic integration. We use larval *Drosophila* to systematically study these processes at single-cell and single synapse resolution.

We use a bipartite approach including serial section electron microscopy and light microscopy analysis of novel genetic tools to reconstruct every single neuron and all synapses in the entire larval brain (connectome).

As a proof of principle, we describe a project focusing on the mushroom body, which consists of about 110 instrinsic Kenyon cells, 24 output neurons, 7 dopaminergic input neurons, 4 octopaminergic input neurons, 5 additional input neurons, and a GABAergic feedback neuron per hemisphere. At the synaptic level, we show further subdivision of the mushroom body into 11 functional subunits, all organized by a conserved connectivity motif defined by individual input, output, and intrinsic neurons.

We further aim to integrate the data into a newly established standard atlas for the larval brain via a five-part approach. It includes generation of an image registration framework, generation of a brain template, segmentation and denomination of identified brain structures, registration of several thousand Gal4 and split-Gal4 stocks onto the template, and the organization of the obtained information in a web-based open access database.

Taken together this work provides a rich picture to support and enhance future studies on the larval brain on multiple levels.