



Press release no. 76/2017

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09 August 2017 08:08:00

Mapping the brain

Researchers from the University of Konstanz contribute in constructing the first circuit map of a brain's learning and memory centre

A significant development in understanding the brain: As part of her doctoral thesis, Katharina Eichler, a doctoral student at the University of Konstanz under the supervision of the neurobiologist Dr. Andreas Thum, has for the first time ever described the mushroom body connectome within the brain of fly larvae (*Drosophila melanogaster*) – the circuit diagram of nerve cells. In the past several years, and in close cooperation with the Janelia Research Campus of the Howard Hughes Medical Institute in Virginia, these neurobiologists used high resolution 3D electron microscopy to reconstruct nerve cells and their individual connections via synapses. The examination of this circuit will be instrumental in guiding future research on how the brain learns new things and then stores these as memories. The research results were published in the 10 August 2017 edition of the journal “Nature” under the title: “The complete connectome of a learning and memory center in an insect brain”

Katharina Eichler manually recorded all of the approximate four hundred cells and reconstructed every one of the roughly one hundred thousand synapses in a microscopically photographed larval brain. The research carried out by the researchers at the University of Konstanz represents a significant contribution towards the overall aim of the international collaboration project led by Dr. Albert Cardona from the Janelia Research Campus: to create a complete wiring diagram of the entire brain of *Drosophila* larvae. Towards this end, researchers in more than 20 labs from around the world are collaborating to reconstruct all of the 10,000 nerve cells. With the modelling of the mushroom body, the researchers from Konstanz have reconstructed almost 8,000 cells of this multi-purpose brain structure. In the next two to three years, all of the connections within the insect brain will be mapped out.

“The brain's mushroom body is also its memory centre in which sensory information is collected and memory is created. It is therefore essential for understanding the brain. Not only were we able to completely reconstruct this crucial component of the brain, but we also documented the existence of new circuit connection patterns between individual cells,” says Andreas Thum about the successful research being carried out at the University of Konstanz. These new circuit connection patterns are already serving as the basis for additional research projects.

Original publication:

Eichler, K., et al. The Complete Connectome Of A Learning And Memory Center In An Insect Brain. Nature, 10 August 2017 edition

Facts:

- Mushroom body connectome in the brain fly larvae (*Drosophila melanogaster*) is illustrated for the first time ever.
- The project was funded by the German Research Foundation (DFG), the German Academic Exchange Service (DAAD), Research Campus Janelia's Visiting Scientist Program, the Baden-Württemberg Foundation and the Zukunftskolleg of the University of Konstanz.
- Collaboration partners:
Albert Cardona, Marta Zlatic and James W. Truman, Janelia Research Campus of the Howard Hughes Medical Institute (Virginia, USA)

Bertram Gerber, Leibniz Institute for Neurobiology (Magdeburg, Germany)

Larry Abbott, Mortimer B. Zuckerman Mind Brain Behavior Institute, Department of Neuroscience, Columbia University (New York, USA)

Note to the editors:

The following is a selection of photos available for download:

1) Light microscopic image of a fly larvae brain (*Drosophila melanogaster*)

https://cms.uni-konstanz.de/fileadmin/pi/filesserver/2017/Andreas_Thum/bild%201.jpg

2) Electron microscopic reconstruction of individual brain nerve cells

https://cms.uni-konstanz.de/fileadmin/pi/filesserver/2017/Andreas_Thum/bild%202_hoch.jpg

3) Reconstruction of the so-called mushroom body, the learning and memory centre of a fly larvae brain

https://cms.uni-konstanz.de/fileadmin/pi/filesserver/2017/Andreas_Thum/bild%203_hoch.jpg

4) Example of an individual reconstructed cell (violet) in the fly larvae brain

https://cms.uni-konstanz.de/fileadmin/pi/filesserver/2017/Andreas_Thum/bild%204_hoch.jpg

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