Team releases 74,000 fruit fly brain images for neuroscience research

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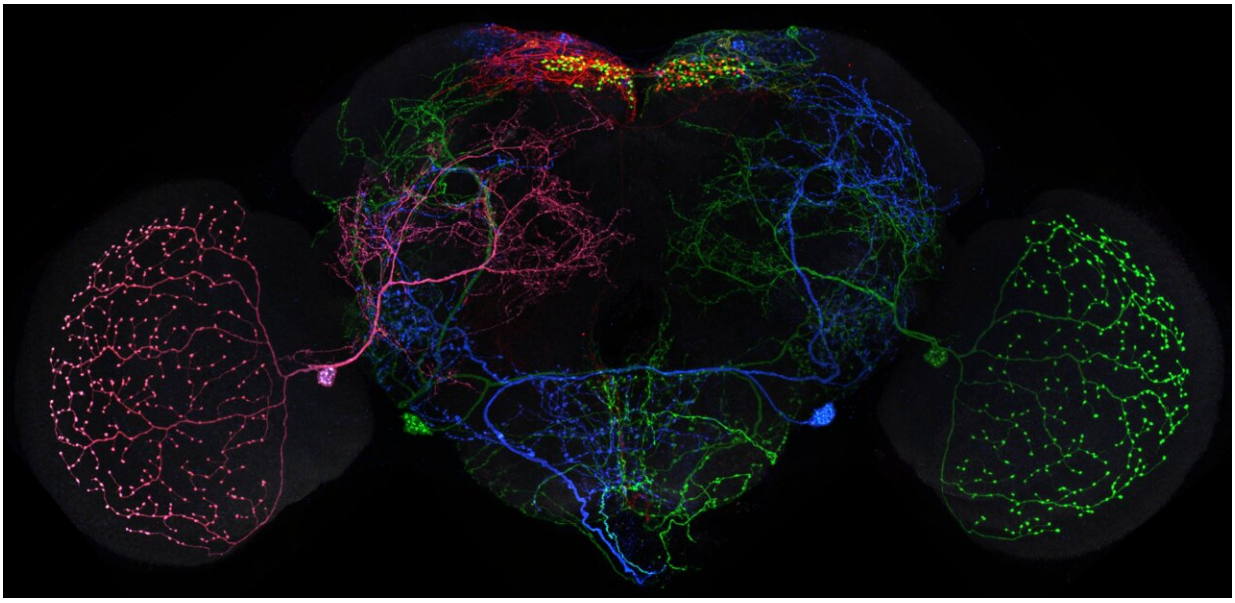

Neurons from the fly brain of a GAL4 line, VT032228-GAL4, labeled in different colors with the fly brain outlined in gray. Individually labeling these neurons allows scientists to clearly see their shape. If the same neuron is labeled by two different GAL4 lines, these lines can be combined so the neuron can be specifically labeled and manipulated. Credit: Geoffrey Meissner/FlyLight

Neuroscience research just got a little bit easier, thanks to the release of tens of thousands of images of fruit fly brain neurons generated by Janelia's FlyLight Project Team.

Over eight years, the FlyLight Project Team and collaborators dissected, labeled, and imaged the neurons of more than 74,000 fruit fly brains, taken from more than 5,000 different genetically modified fly strains.

Now, these images are being made freely available, enabling scientists to quickly and easily find the neurons they need to test theories about how the nervous system works.

The release of the images February 23 in the journal *eLife* is the culmination of years of effort and contributions from dozens of Janelians, starting in 2012. It demonstrates Janelia's commitment to creating free resources useful to the entire scientific community. It also highlights the research campus's mission to take on projects that can't be accomplished in a traditional research environment where these long-term efforts are often not funded or incentivized.

"It is a great resource for the community," says Geoffrey Meissner, who was the project scientist for FlyLight and the first author of the new paper in *eLife*. "It's very squarely in Janelia's mission, and it highlights the Project Teams as a concept—of doing these big things beyond the scale of what a lab could reasonably do—and really emphasizes the open science aspect of Janelia's goals. We want to go the extra mile to make it available to everybody, to make it easy, to make it more comprehensive."

Using fruit flies for neuroscience research

The fruit fly Drosophila melanogaster is a staple of neuroscience research. Scientists use genetically engineered fruit flies to target the expression of certain neurons, allowing researchers to understand which brain cells control certain behaviors.

Scientists were using fruit flies to understand the nervous system when

Janelia opened in 2006, but researchers did not have tools precise enough to implicate individual neurons.

That led Janelia to create the FlyLight Project Team, which set out to create genetically engineered flies that scientists could use to home in on specific neurons with more precision. In 2012, Janelia released the first generation of those fly strains, the Generation 1 GAL4 driver lines, along with microscopy images showing where in the brain specific neurons resided.

But the Generation 1 lines were still too imprecise for some neuroscience research. So FlyLight developed strains of fruit flies from these GAL4 lines using the Split-GAL4 approach that enabled scientists to identify single neurons or single cell types in the fly brain.

Since they were developed, the Split-GAL4 lines and the Split-GAL4 system have been used by researchers worldwide. But figuring out how to create a specific Split-GAL4 needed for an experiment can be challenging. To do this, researchers first need to label neurons of interest in GAL4 lines—a task that can be difficult for a single researcher.

To help, the FlyLight team used a technique called MultiColor FlpOut (MCFO), developed by Aljoscha Nern, a senior scientist in the Rubin Lab, to label individual neurons in Generation 1 GAL4 driver lines. Generating the more than 70,000 detailed images now being released required over 11 years of imaging time on 8 confocal microscopes.

Janelia's Scientific Computing team created a freely available tool called NeuronBridge that allows researchers to search the MCFO-labeled images, along with other light and electron microscopy data, to home in on neurons of interest. It also enables researchers to predict the Split-GAL4 combinations they will need for their experiments.

"FlyLight made a lot of images, but without our close collaboration with Scientific Computing, it would just be terabytes of data sitting on a hard drive that nobody could do anything with. They played a key role in making it usable for people," says Meissner, who is now senior manager of Project Pipeline Support, which continues to offer FlyLight pipelines to Janelia labs.

A worldwide resource

The publication marks the official release of the images, but neuroscientists all over the world have already been taking advantage of the data since their initial release in 2020.

The latest effort builds on Janelia's reputation for developing tools that facilitate fruit fly research.

"The general feeling is that for anybody doing fly neuroscience who wants to target a neuron and learn something about it, the best way is using the GAL4 lines characterized by FlyLight," Meissner says.

More information: Geoffrey Wilson Meissner et al, A searchable image resource of Drosophila GAL4-driver expression patterns with single neuron resolution, *eLife* (2023). DOI: 10.7554/eLife.80660

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