IMAGING

Micro-CT to see the whole fly

Schoborg, T.A., Smith, S.L., Smith, L.N., Morris, H.D., and Rusan, N.M. *Development* **146**, dev176685 (2019)

Drosophila melanogaster has a century-old history of helping researchers dissect the smallest details of fundamental biological mechanisms. That work has relied heavily on imaging, from electron microscopes to examine ultrastructural features to light microscopes to explore samples of cells, tissues, and even whole organs. But, the largest scale of the biological hierarchy had more or less been missing: that of the whole organism.

"If we want to really try to connect biological mechanisms across all of these spatial scales, we need to have the tools," says Todd Schoborg, a fly researcher now at the University of Wyoming. While a post-doc with Nasser Rusan at the NIH, Schoborg took on tool development to complete the fly imaging pipeline.

After considering several whole-organism options, Schoborg and his colleagues settled on micro-computed X-ray tomography (micro-CT), a commercially available technology that can be found at most institutions and has been used with a number of model vertebrates already.

Adapting it to an insect, however, took some time. One problem? No bones. In fish, rodents, and other vertebrates, bone differentially attenuates the incoming X-rays to produce an image. Lacking such hard structures, the soft-bodied subjects needed some substance—metal stains did the trick. The team also had to determine how best to preserve and mount the flies in the scanner without altering tissues or letting the flies dry out and shrink. "About a year was spent simply troubleshooting and trying to get an image that even resembled something that was a fly," says Schoborg.

He had started the project to answer questions about just one part of the fly: its brain. But micro-CT's capabilities proved much bigger. With the right protocols in place, images of whole flies from larvae to adults emerged. The scanners even captured flies at pupation, the dynamic and difficult-to-image developmental stage during which larvae metamorphose into adults.

Until the micro-CT technology itself improves, the resolution will be lower than those working with other microscopes may be used to, and the scanners do produce immense amounts of images that need to be segmented and annotated (Wyoming's Artificial Intelligence Center is on it! Schoborg says) but Schoborg is excited by what he's seen. "We're able to watch development happening," he says. "To be able to put those pieces together and say, 'Now we've got a really great tool that is just going to allow us to look at development across these stages we've never looked at before' was actually really cool."

Schoborg hopes to have the images up online soon. In the meantime, he is looking for collaborators who want to explore their own questions with images of the *whole* fly.

Ellen P. Neff

Published online: 10 February 2020
https://doi.org/10.1038/s41684-020-0491-7