New technology solves mystery of respiration in Tetrahymena
31 March 2022

Tetrahymena, a tiny single celled-organism, turns out to be hiding a surprising secret: it's doing respiration—using oxygen to generate cellular energy—differently from other organisms such as plants, animals or yeasts. The discovery, published March 31 in *Science*, highlights the power of new techniques in structural biology and reveals gaps in our knowledge of a major branch of the tree of life.

"We thought we knew about respiration from studying other organisms, but this shows us how much we still don't know," said Maria Maldonado, a postdoctoral researcher in the Department of Molecular and Cellular Biology at the University of California, Davis and co-first author on the paper.

Maldonado, Letts and co-first author Long Zhou used new approaches in structural biology to uncover the Tetrahymena electron transport chain. These included a cryo-electron microscopy structural proteomics approach—working out the structures of large number of proteins in a mixed sample at the same time.
Cryo-electron microscopy freezes samples to extremely low temperatures, creating images at almost atomic resolution. Instead of imaging a single, purified protein, the team worked with mixed samples isolated from mitochondrial membranes and then taught an algorithm to recognize related structures.

In this way, they were able to scan through hundreds of thousands of protein images and identify the structures of 277 proteins in three large assemblies, representing the Tetrahymena electron transport chain at near atomic resolution. Some of these proteins have no matching gene in the known Tetrahymena genome database—showing that there must be gaps in the available reference genome.

By revealing the gaps in our knowledge of a fairly common organism, the work shows our blind spots with respect to biodiversity, Letts said. It also shows the potential of these new methods in structural biology as a discovery tool, he said.

Part of the work was conducted with cryo-electron microscopes at the BioEM core facility at the UC Davis College of Biological Sciences. Additional authors on the paper are Abhilash Padavannil and Fei Guo, both at UC Davis. Zhou is now at Zhejiang University School of Medicine, Hangzhou, China.

www.science.org/doi/10.1126/science.abn7747

Provided by UC Davis

This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.