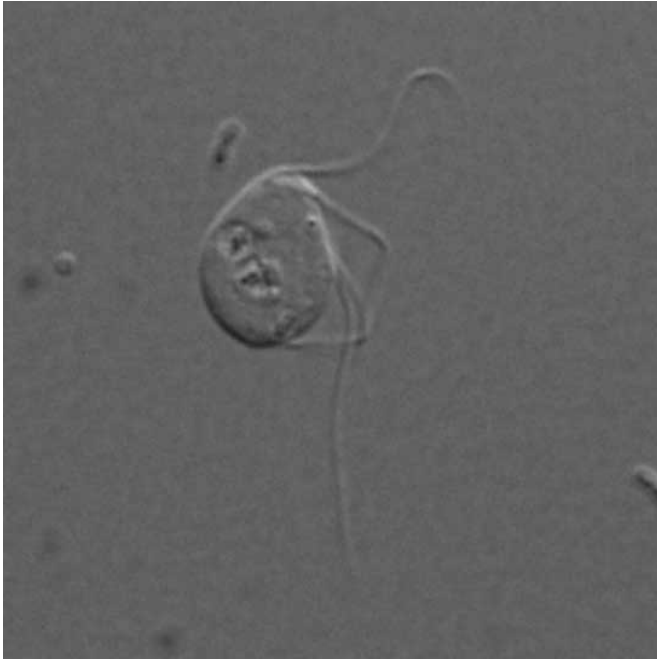


# Surprise! This eukaryote completely lacks mitochondria

12 May 2016



Light micrograph of *Monocercomonoides* sp. (PA203).  
Credit: Dr Naoji Yubuki.

Mitochondria are membrane-bound components within cells that are often described as the cells' powerhouses. They've long been considered as essential components for life in eukaryotes, the group including plants, fungi, animals, and unicellular protists, if for no other reason than that every known eukaryote had them. But researchers reporting in the Cell Press journal *Current Biology* on May 12, 2016 now challenge this notion. They've discovered a eukaryote that contains absolutely no trace of mitochondria at all.

"In low-oxygen environments, eukaryotes often possess a reduced form of the mitochondrion, but it was believed that some of the mitochondrial functions are so essential that these organelles are indispensable for their life," says Anna Karnkowska, a former post-doctoral fellow at

Charles University in Prague who is now at the University of British Columbia in Vancouver, Canada. "We have characterized a eukaryotic microbe which indeed possesses no mitochondrion at all."

Organisms from the genus *Monocercomonoides* have been recognized for more than 80 years. They are related to the human pathogens *Giardia* and *Trichomonas*, all of which belong to a group known as Metamonada, which lives exclusively in low-oxygen environments.

In the new study, Karnkowska and Vladimir Hampl at Charles University in Prague and BIOCEV, along with colleagues from the Czech Republic and Canada, sequenced the *Monocercomonoides* genome. They were surprised to find that this organism lacks all [mitochondrial proteins](#).

*Monocercomonoides* seems to have gotten by without mitochondria thanks to a cytosolic sulfur mobilization system (SUF) that they acquired from bacteria and that appears to substitute for essential mitochondrial functions. Through a unique combination of events including the loss of many mitochondrial functions and the acquisition of this essential machinery from prokaryotes, "this organism has evolved beyond the known limits that biologists circumscribed," Karnkowska says.

Researchers have been looking for organisms lacking mitochondria for decades. As the years went by, it seemed more and more unlikely that a eukaryote that truly lacked mitochondria would ever be found. Nevertheless, Karnkowska, Hampl, and their colleagues now say there may be others.

"This amazing organism is a striking example of a cell which refuses to adhere to the standard cell biology text book, and we believe there may be many more similar examples in the so far hidden diversity in the world of microbial eukaryotes—the protists," Karnkowska says.

The researchers say they'd now like to learn more about how these organisms function. They'd also like to better characterize *Monocercomonoides* and its relatives to understand their discovery in a broader, evolutionary context.

"It is very likely that the mitochondrion is absent in the whole group called oxymonads," senior author Vladimir Hampl says. "We would like to know how long ago the mitochondria were lost."

**More information:** Karnkowska et al.: "A Eukaryote without a Mitochondrial Organelle" *Current Biology*, [http://www.cell.com/current-biology/fulltext/S0960-9822\(16\)30263-9](http://www.cell.com/current-biology/fulltext/S0960-9822(16)30263-9) , DOI: [10.1016/j.cub.2016.03.053](https://doi.org/10.1016/j.cub.2016.03.053)

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