Amoeba Genome Shows Evolution of Complex Life

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(PhysOrg.com) -- An amoeba with a split personality is giving biologists clues to the ancestry of organisms from fungi to people and insight into how complex organisms evolved.

"We tend to think of protists (single-celled organisms) as 'simple' and humans as 'complex' -- but the Naegleria genome shows us that much of this complexity arose really early in evolution," said Scott Dawson, assistant professor of microbiology at UC Davis.

Dawson is senior author on the paper analyzing the genome of Naegleria gruberi, published in the March issue of the journal *Cell*. The team also included UC Davis graduate students Michael Cipriano and Jonathan Pham. Dawson had initially proposed N. gruberi as a candidate for genome sequencing back in 2004 while he was a postdoctoral researcher at UC Berkeley.

N. gruberi slurps around in mud as an amoeba but when food runs low it sprouts two whip-like tails, or flagellae, and swims rapidly away. It can also transform into a hard, resistant cyst to wait out bad conditions.

Most previous efforts to sequence the genomes of protozoa have focused on parasitic organisms such as the malaria parasite.

"Because it's free living, it can tell us a lot about early life -- it has genes to do all these different things," Dawson said.

The analysis shows that N. gruberi has 15,727 genes that code for proteins, compared to about 23,000 in humans. With those genes, the organism can eat and reproduce, crawl or swim, live with or without oxygen, and organize itself internally much as a human cell does.

The human body also includes cells that can crawl, such as white blood cells, or that have whiplike tails, such as sperm -- although none that do both. So humans also carry both sets of genes, as did the common ancestor we share with N. gruberi.

The researchers compared N. gruberi's genome to a wide range of other eukaryotes -- organisms that separate their DNA from the rest of the cell -- including green plants, fungi, humans and other single-celled organisms, and found a set of about 4,000 genes that could be traced back to a single ancestor over a billion years ago. Many of those genes have no known function, Dawson said.

"There's a lot of undiscovered biology there," he said.

N. gruberi is harmless to humans, but it does have a relative called Naegleria fowlerii that lives in murky water and can -- rarely -- swim up your nose and eat your brain.

Sequencing was carried out at the U.S. Department of Energy's Joint Genome Institute in Walnut Creek. The joint first authors on the paper published in *Cell* were Lillian Fritz-Laylin, UC Berkeley and Simon Prochnik, Joint Genome Institute.

Provided by UC Davis