

# Structures of Tetrahymena's respiratory chain reveal the diversity of eukaryotic core metabolism

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Respiration is a core biological energy-harvesting process whose last steps are carried out by a chain of multi-subunit complexes in the inner mitochondrial membrane. To probe the functional and structural diversity of eukaryotic respiration, we examined the respiratory chain of the ciliate *Tetrahymena thermophila*. Our reconstructions of the supercomplex between Tt-CI and Tt-CIII2 (Tt-SC I+III2) and Tt-CIV2 from a mixed cryoEM sample explained functional divergence relative to other eukaryotes. Tt-SC I+III2 (~2.3 MDa) is a curved assembly with structural and functional symmetry breaking. Tt-CIV2 is a ~2.7 MDa dimer with over 52 subunits per protomer, including mitochondrial carriers and a TIM86-like domain. Our structural and functional study of the *T. thermophila* respiratory chain reveals the diversity of eukaryotic respiration, expanding our understanding of core metabolism.