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PERSPECTIVES

EVOLUTION:

**Tinkering Inside the Organelle**

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Among the questions about the evolution of eukaryotes is the debate over how they acquired the membrane-bound organelle, mitochondria. Mitochondria produce energy in nearly all eukaryotic cells ([1](#)) and regulate cell metabolism by controlling the flow of factors such as ions, amino acids, and carbohydrates between themselves and the cytoplasm. Mitochondria evolved from a bacterial endosymbiont (an  $\alpha$ -proteobacterium), and this process depended on the establishment of new pathways that facilitated the import of proteins into and across the double membrane (inner and outer) of the ancestral endosymbiont. Herein lies a debate: How did the process of protein import in mitochondria—which facilitated the evolution of this organelle, and thus, eukaryotic cell evolution—arise? Was the process driven by the ancestral host cell or by the prokaryotic endosymbiont, or by both?

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