

"Inside" "same" "life"  
"true" "kernel"  
Name: \_\_\_\_\_ refers to the nucleus.  
**The Endosymbiotic Theory of Eukaryote Evolution**

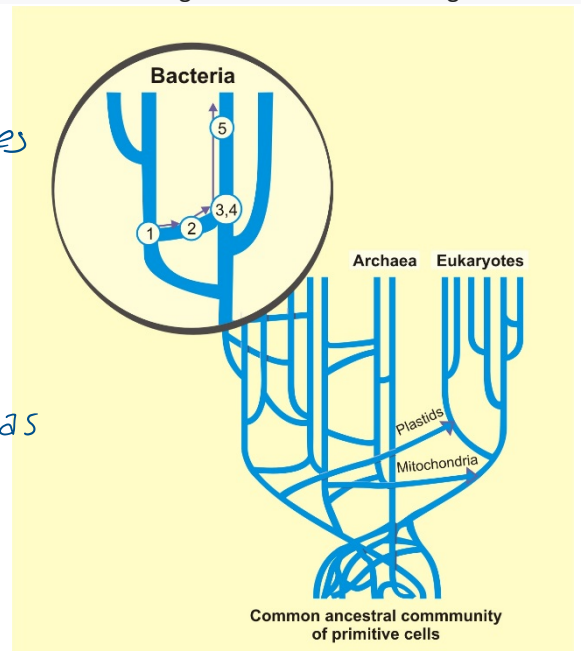
How **eukaryotes** evolved from **prokaryotes** (the Bacteria and the Archaea) has long puzzled biologists because of the vast differences between prokaryotes and eukaryotes.



Dr. Lynn Margulis  
1938-2011  
By Jpedreira - Self-published work  
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- Eukaryotes are about 1000 times bigger than prokaryotes
- Prokaryotes have a single strand of DNA (and some smaller circular ones); Eukaryotes have **chromosomes**, strands of DNA wrapped around **histones**, separated from the rest of the cell by a **nuclear membrane**.
- Prokaryotes undergo **binary fission** while eukaryotes use **mitosis**.
- Eukaryotes have **membrane-bound organelles** like mitochondria, endoplasmic reticulum, a nucleus, and prokaryotes have none.
- Eukaryotes have **sex**. Prokaryotes do not.

Tree of life showing vertical and horizontal gene transfers

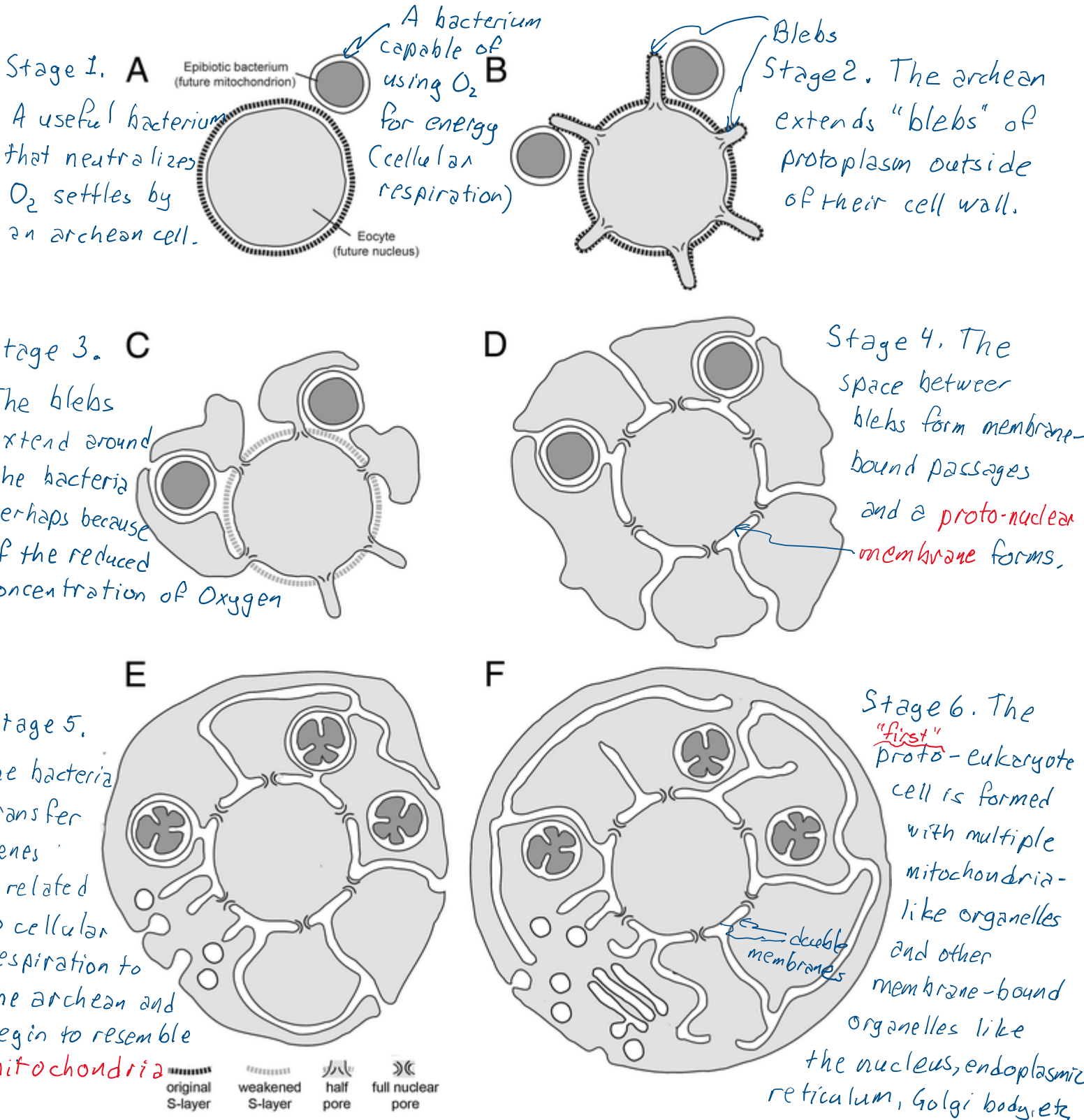


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The idea of **endosymbiosis** and eukaryotes first arose with German botanist Andreas Schimper. Noticing that plant **chloroplast** look identical to some **cyano bacteria** proposed the idea that chloroplasts were symbiotic **cyano bacteria**.

In the 1960's Lynn Margulis proposed the idea that the cell **nucleus** was a result of an endosymbiotic bacterium. Her initial idea was mostly rejected. However, she kept researching the idea and it morphed into the now accepted idea that the cells **mitochondria** are the result of an endosymbiotic

Two cousins named Baum proposed the "Outside In" model of Eukaryotic evolution. The steps are as follows:



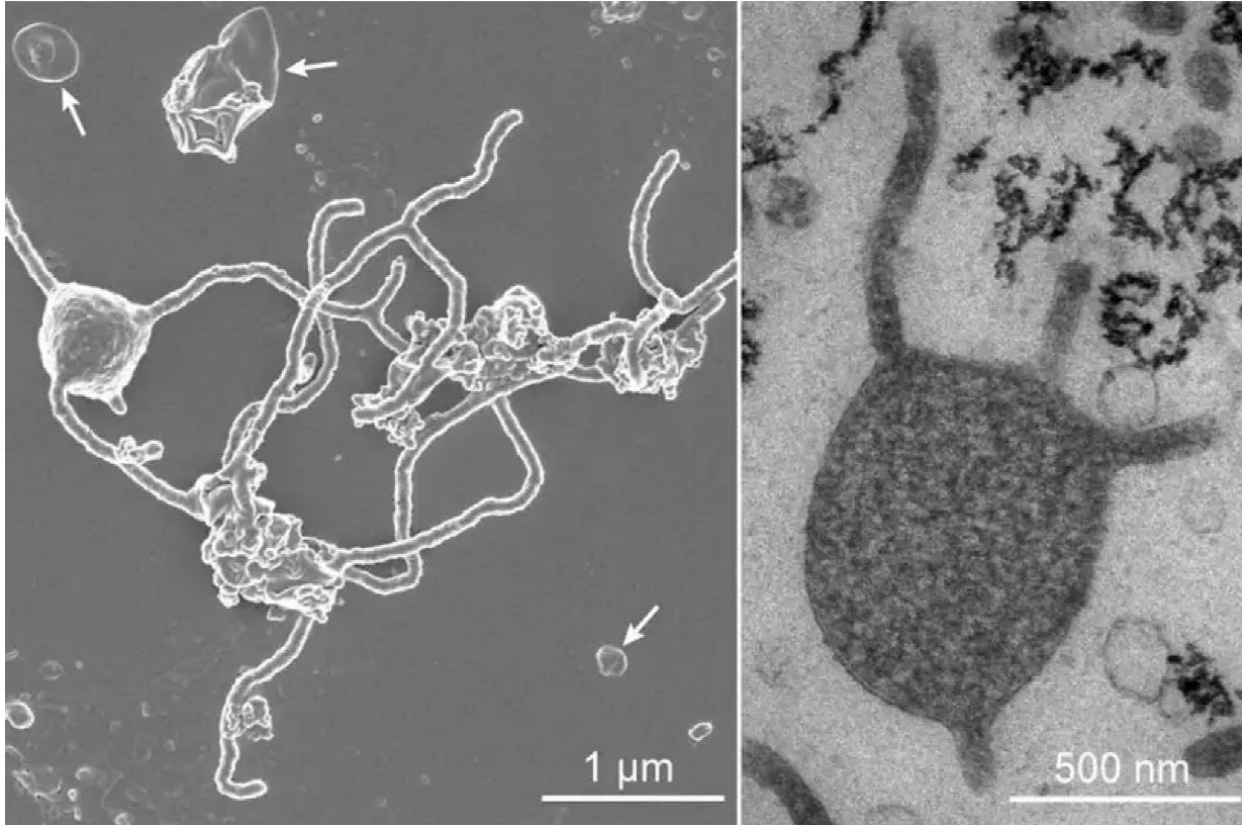
This is one possible way that the endosymbiosis could have happened.

The important points for the Endosymbiotic Evolution of Eukaryotes are:

- Mitochondria have their own genes that they use for their function — cellular respiration, making **ATP**.
- Mitochondria divide on their own, often at the same time as the cell divides.
- Mitochondria are much smaller than the cell, about 500 nm (nanometres) in diameter.

Name: \_\_\_\_\_

Research on a thermal vent grouping called *Loki's Castle* in the North Atlantic showed an archaeon with extensions encircling bacteria, as in the Baum-Baum model. The microorganisms here are referred to as the *Asgard assemblage*.



Hiroyuki Imachi and his team devised a culture protocol that allowed them to grow members of the Asgard archaea for the first time. Imachi calls the organism *Prometheoarchaeum syntrophicum*. His team were able to photograph (above) and study its behaviour. It is a possible ancestor of the archaea that "swallowed" a bacterium leading to the evolution of the Eukaryota.

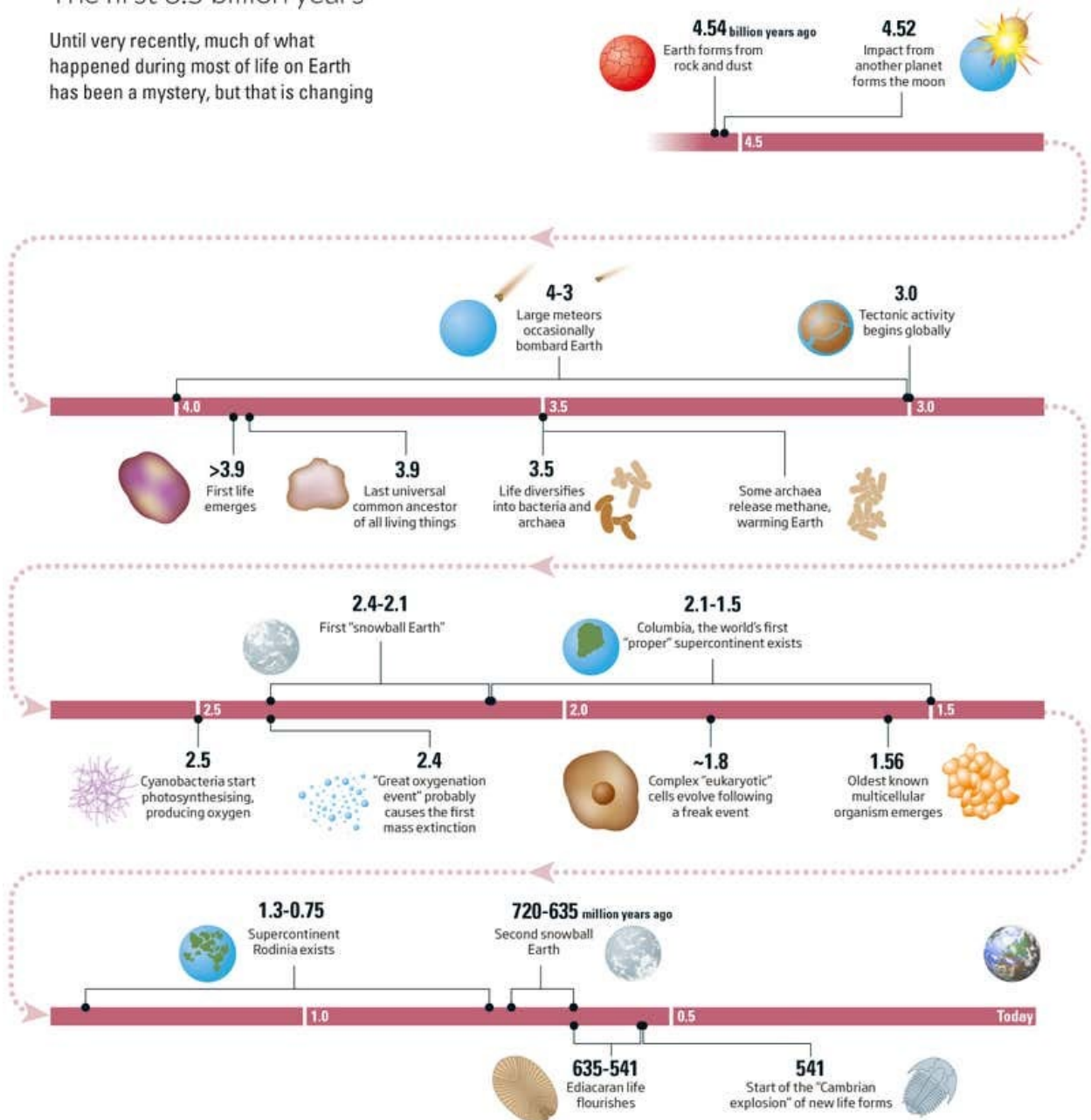
<https://www.newscientist.com/article/2213037-deep-sea-microbe-could-answer-one-of-evolutions-biggest-mysteries/>

Article accessed 2019/10/2.



### The first 3.5 billion years

Until very recently, much of what happened during most of life on Earth has been a mystery, but that is changing



"In the beginning: the full story of life on Earth can finally be told," by Michael Marshall, *New Scientist*, issue 3212. Published 12 January 19, amended 6 February 2019.