

Hvad er liv?

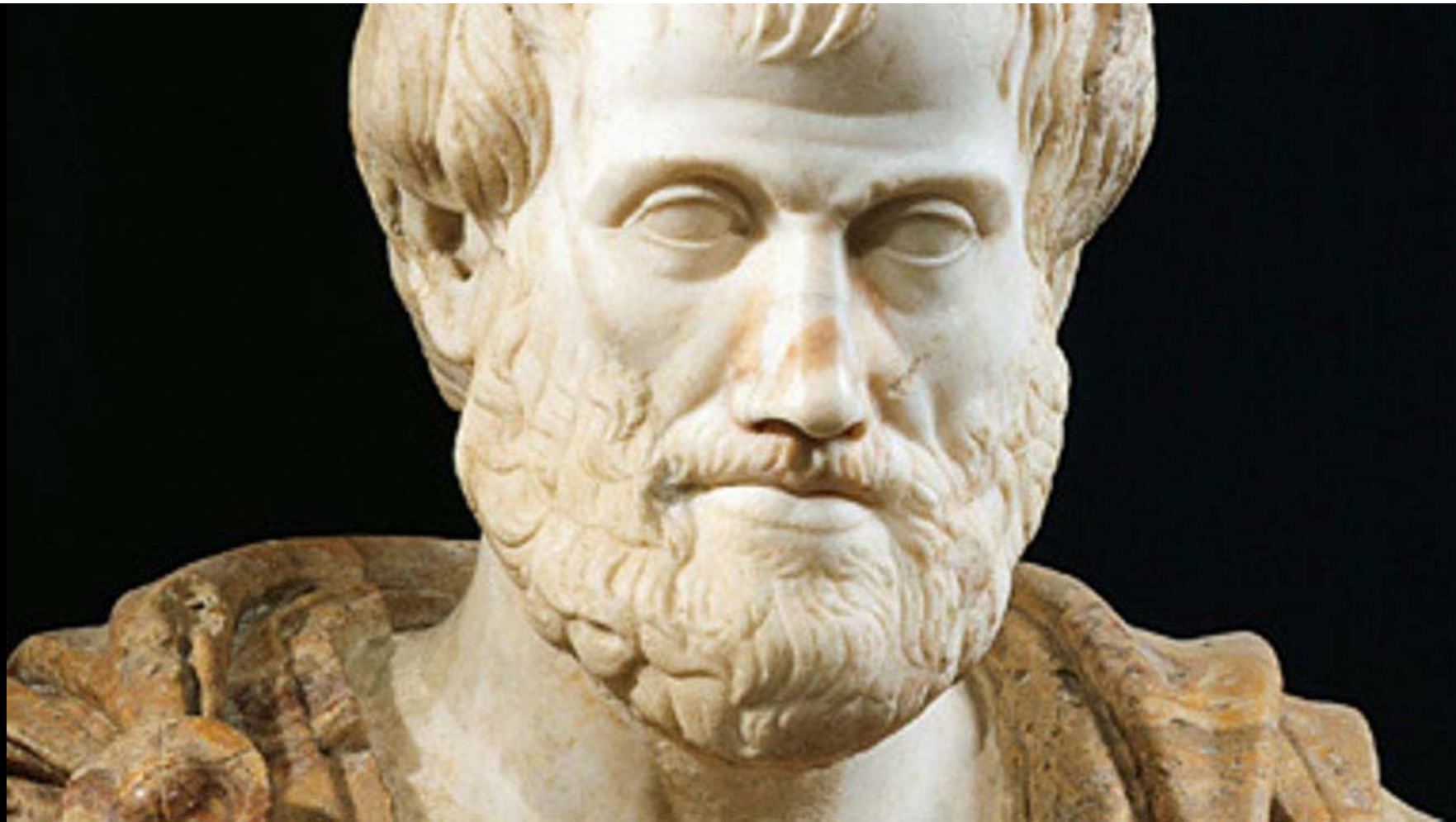
NASA definer liv som

*“A self-sustaining chemical system
capable of Darwinian evolution.”*



Hvad kræves for liv?

- i) En adskillelse fra omgivelserne (cellemembranen), men også en mulighed for at kunne udveksle stoffer med omgivelserne
- ii) Homeostase – dvs et regulerende der system der kan fastholde cellens koncentrationer af forskellige stoffer
- iii) Et stofskifte til at opbygge nye stoffer, men også til at lave energi for at opretholde homeostase
- iv) Mulighed for reproduktion (et arvemateriale)



Animals and plants come into being in earth and in liquid because there is water in earth, and air in water, and in all air is vital heat so that in a sense all things are full of soul. Therefore living things form quickly whenever this air and vital heat are enclosed in anything.

— Aristotle, *On the Generation of Animals*, Book III, Part 11

Jan Baptist van Helmont
(1580 – 1644)

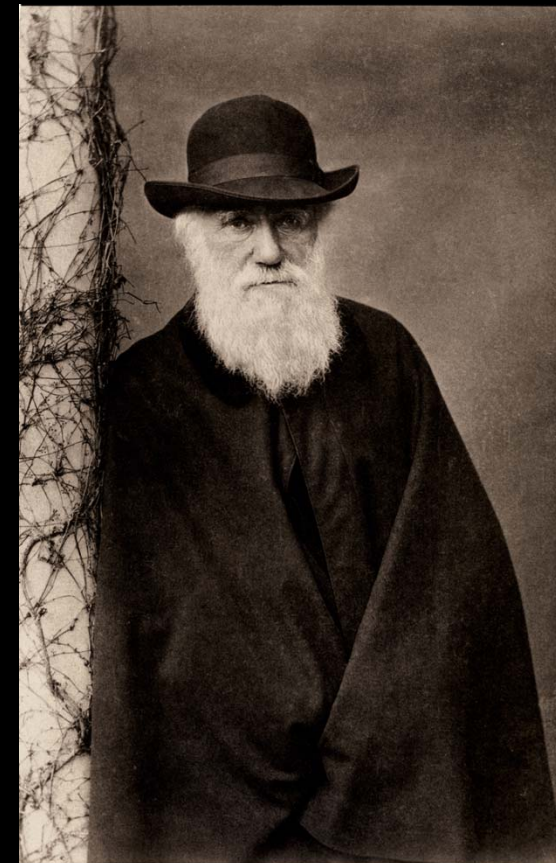






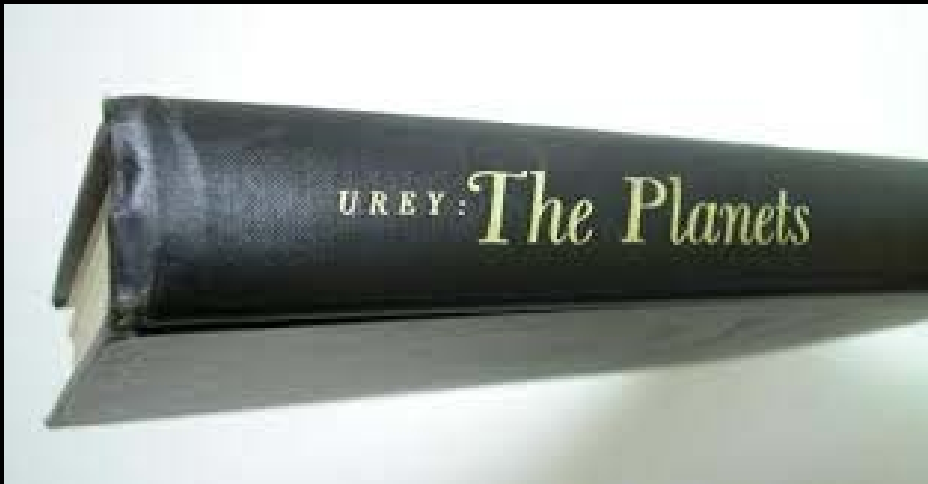
Charles Darwin (1871) til vennen Joseph Dalton Hooker:

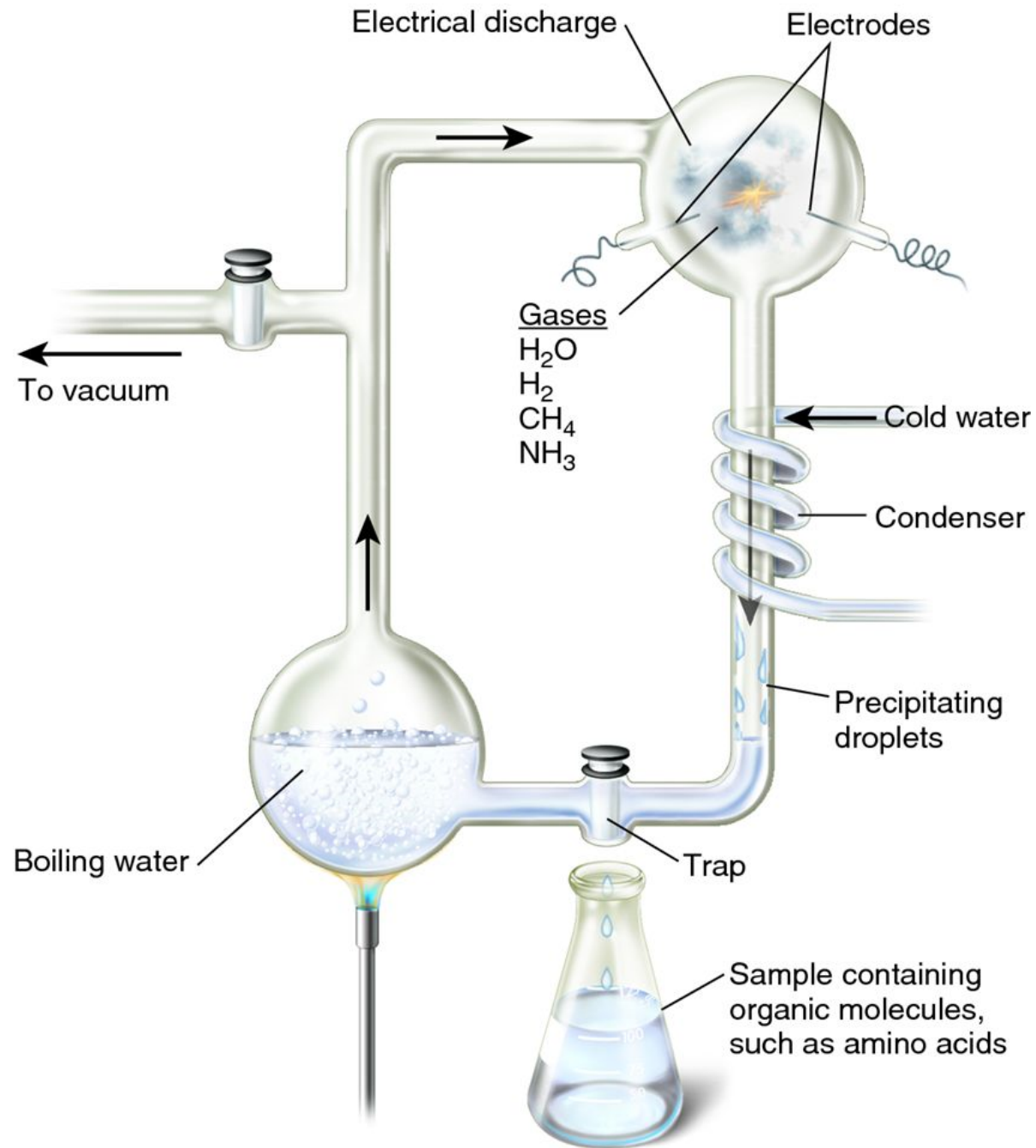
”Men hvis vi kunne forestille os en varm lille dam med alle mulige slags ammoniak, fosforsalte, lys, varme og elektricitet, hvor et protein blev kemisk dannet, som derefter undergik yderligere ændringer ...”

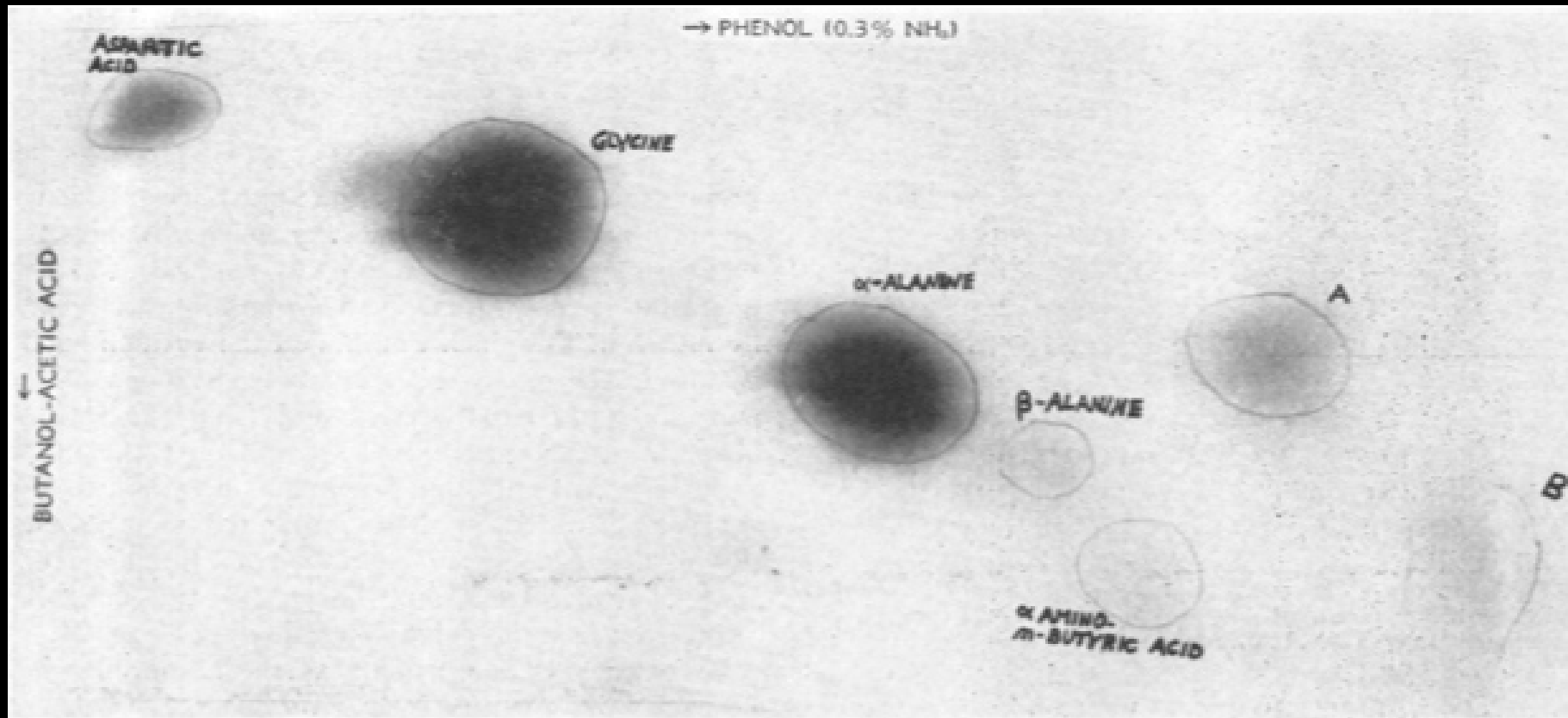


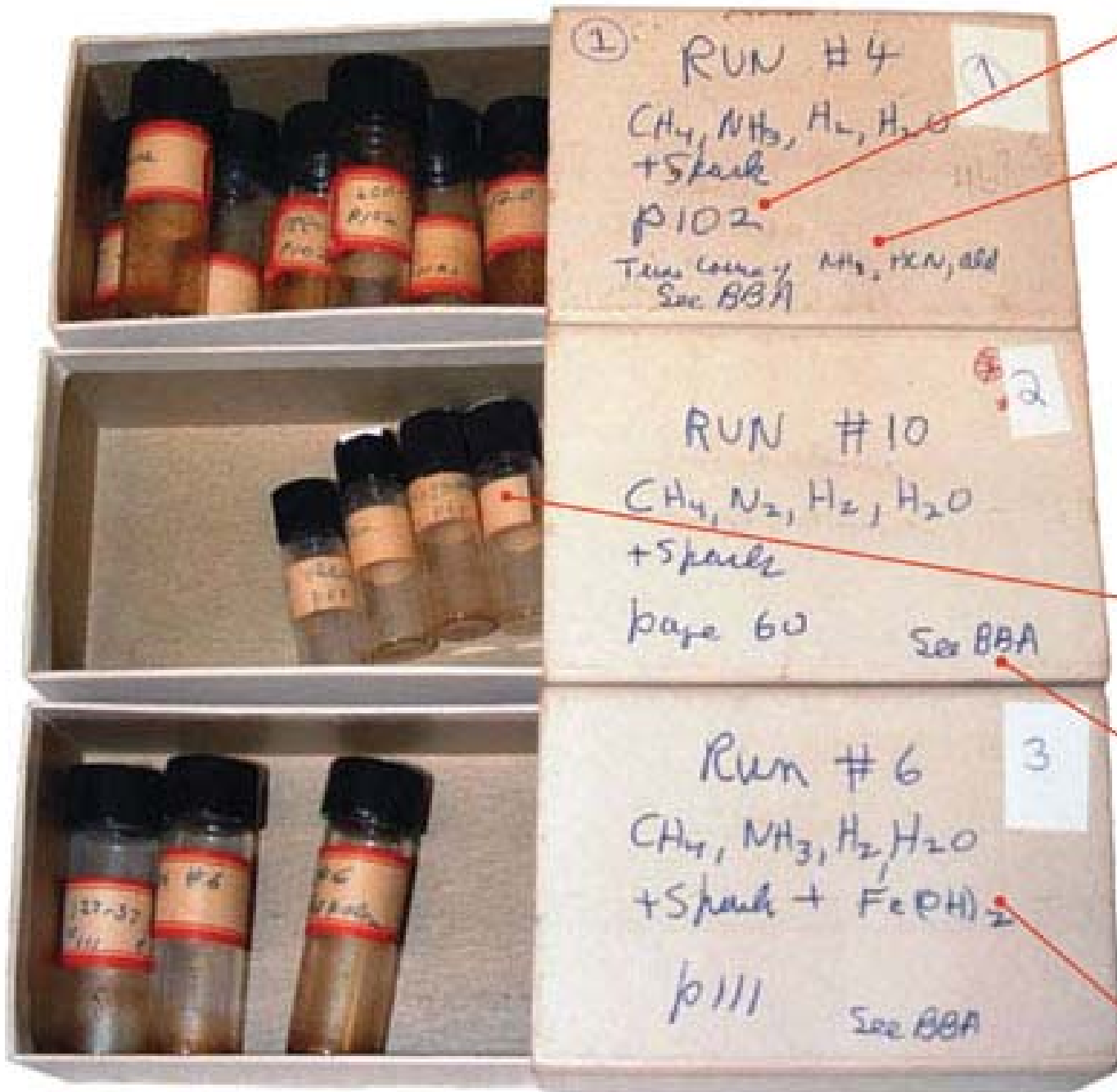


den russiske biokemiker
Alexander I. Oparin (1894-1980)
og engelske evolutionsbiolog
John B.S. Haldane (1892-1964)









① RUN #4
CH₄, NH₃, H₂, H₂O
+ Sparks
p102
Texas College of
Sci. BBA

1

NH₃, HCN, ald

Page number in Miller's notebook

Miller checked for the concentration of ammonia, hydrogen cyanide, and aldehydes, considering the latter two as precursors to amino acids.

RUN #10
CH₄, N₂, H₂, H₂O
+ Sparks
page 60
Sci BBA

2

Each vial contains dried residue from the experiments, mostly amino acids.

RUN #6
CH₄, NH₃, H₂, H₂O
+ Sparks + Fe(OH)₂
p111
Sci BBA

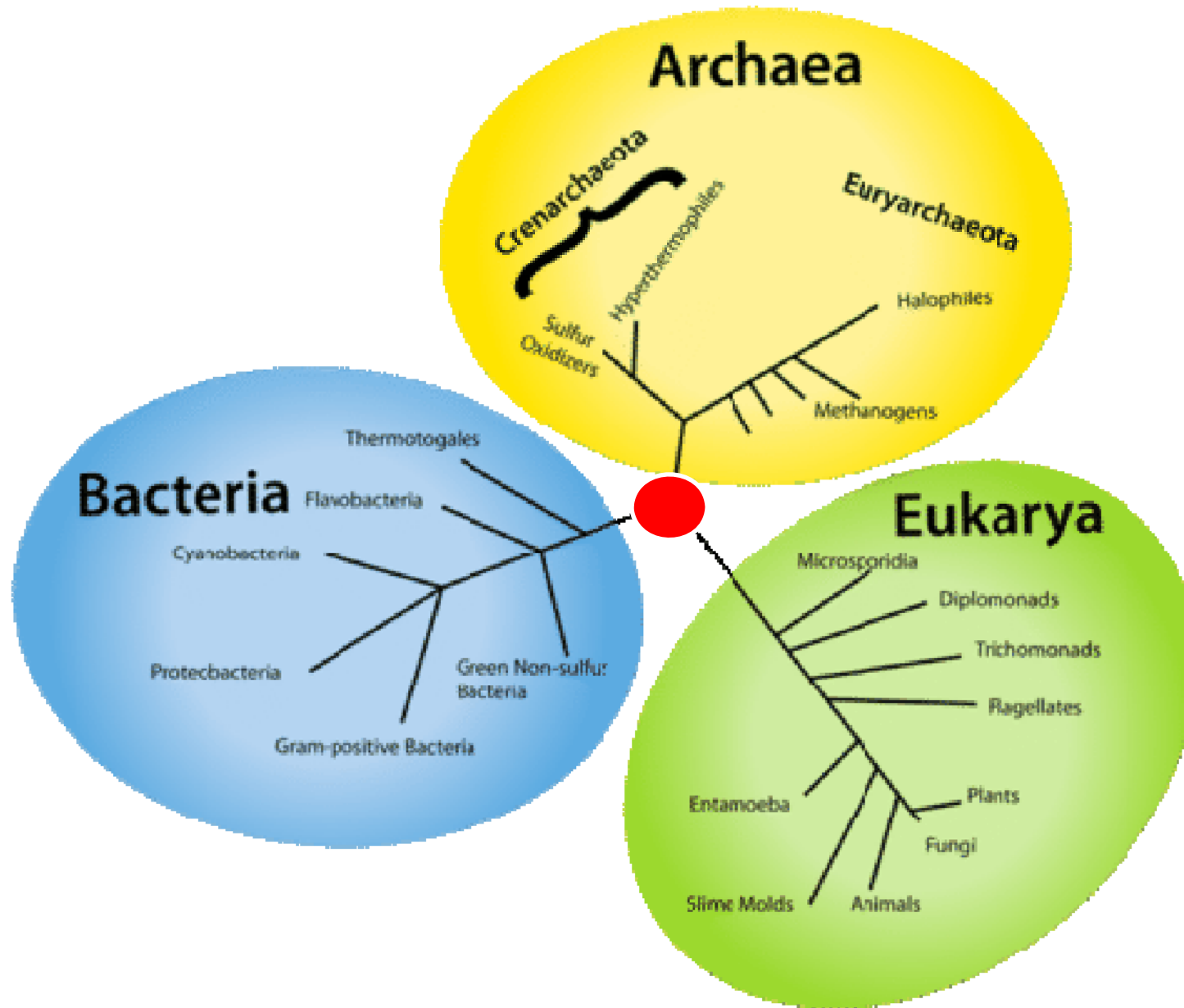
3

Miller's 1957 paper Biochemica et Biophysica Acta

In this experiment, Miller added ferrous iron hydroxide, since some scientists suspected the early earth carried a lot of reduced iron, Johnson says.

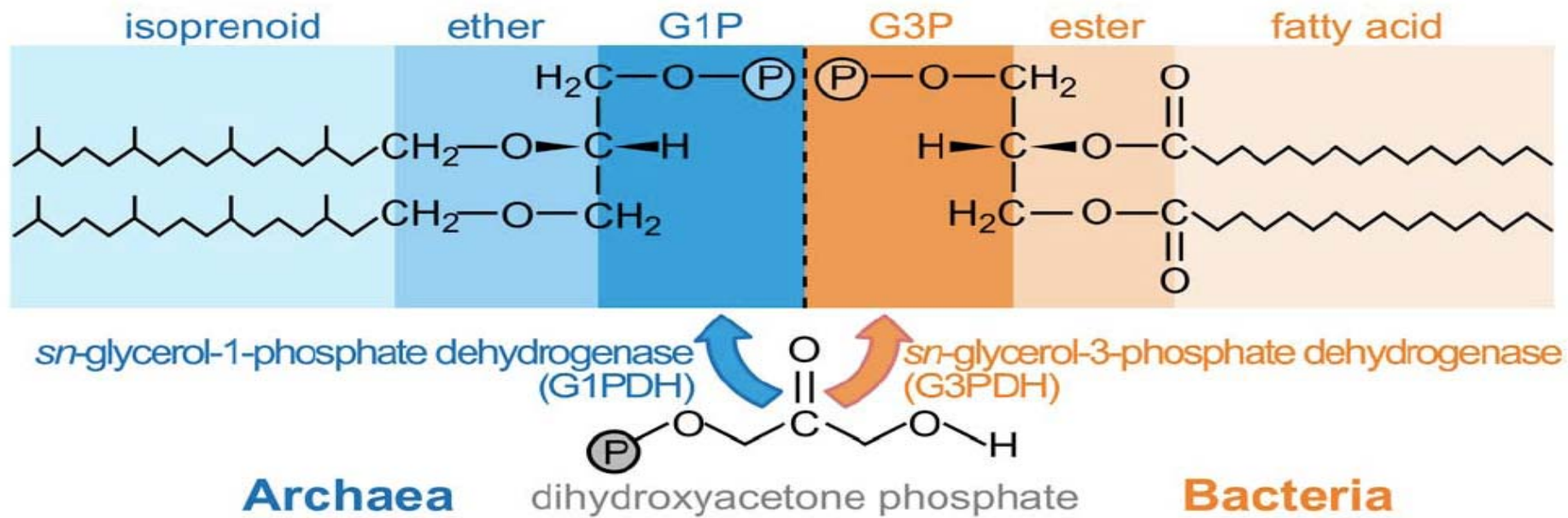


Last Universal Common Ancestor (LUCA)

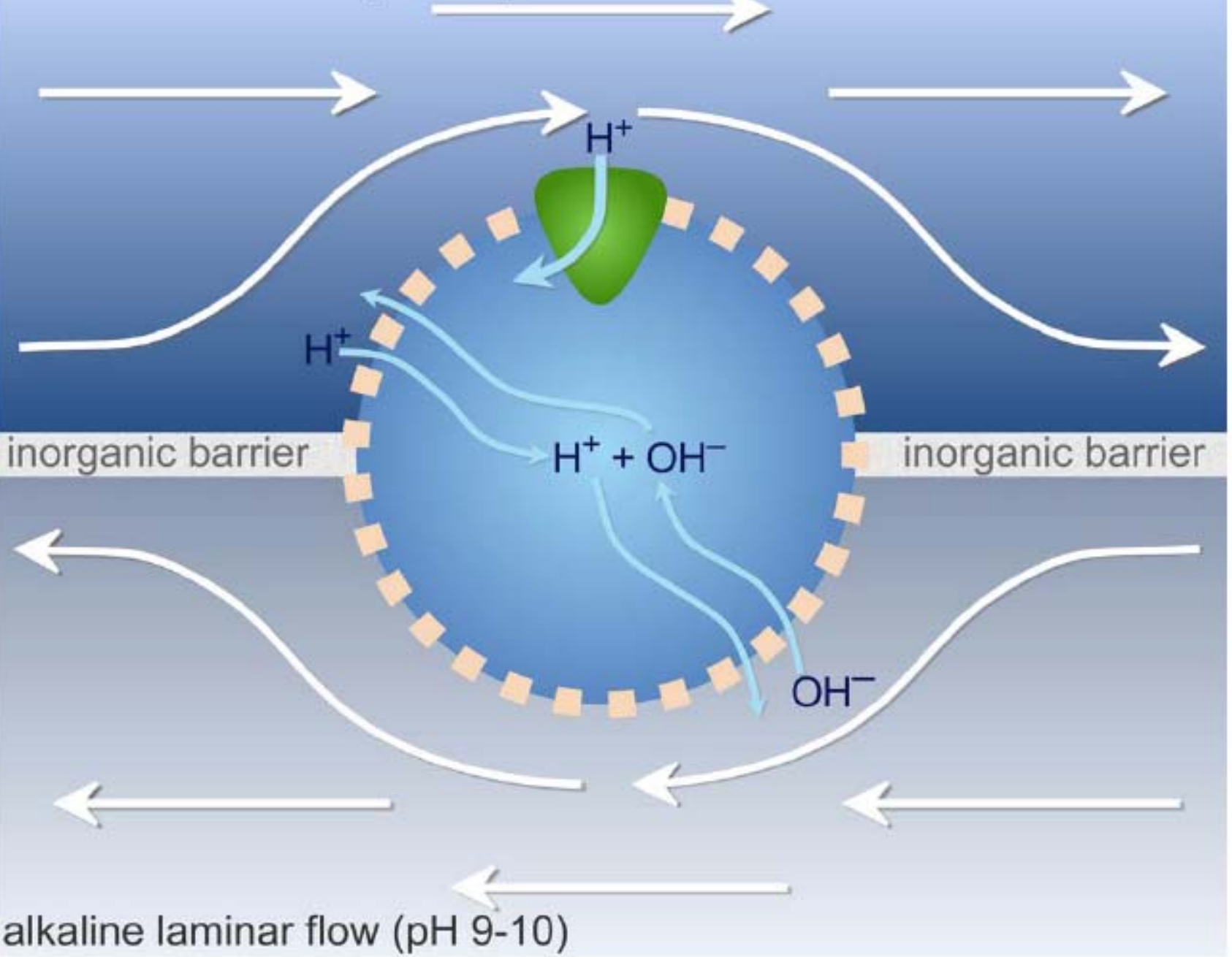


Archea og bakterier er forskellige mht cellemembranen sammensætning og DNA replication

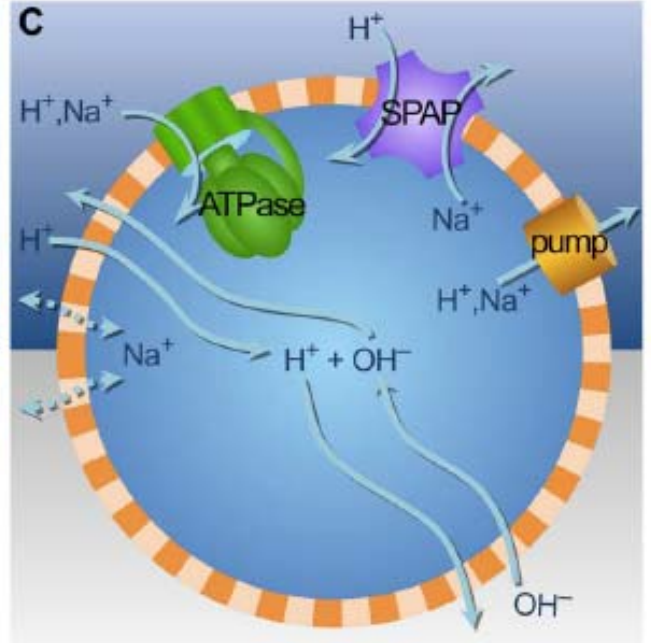
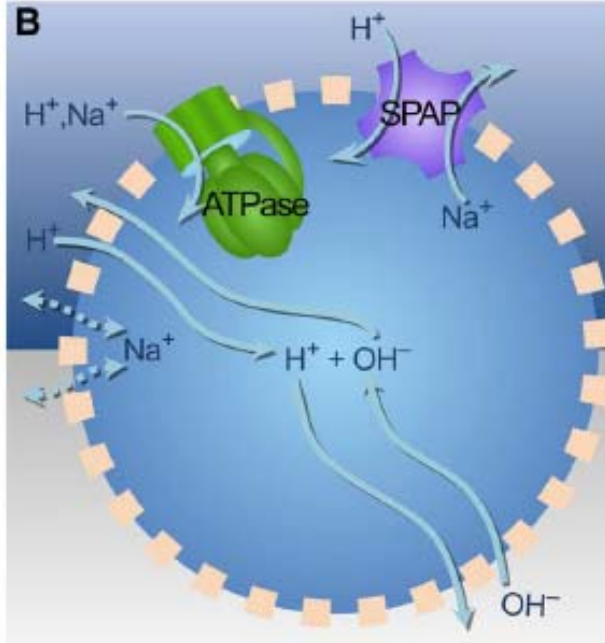
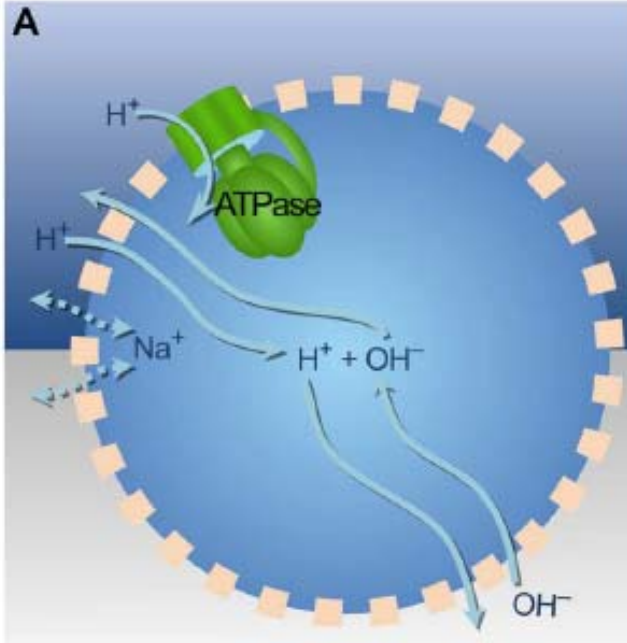
Hvordan kan så centrale dele af livet være forskellige?

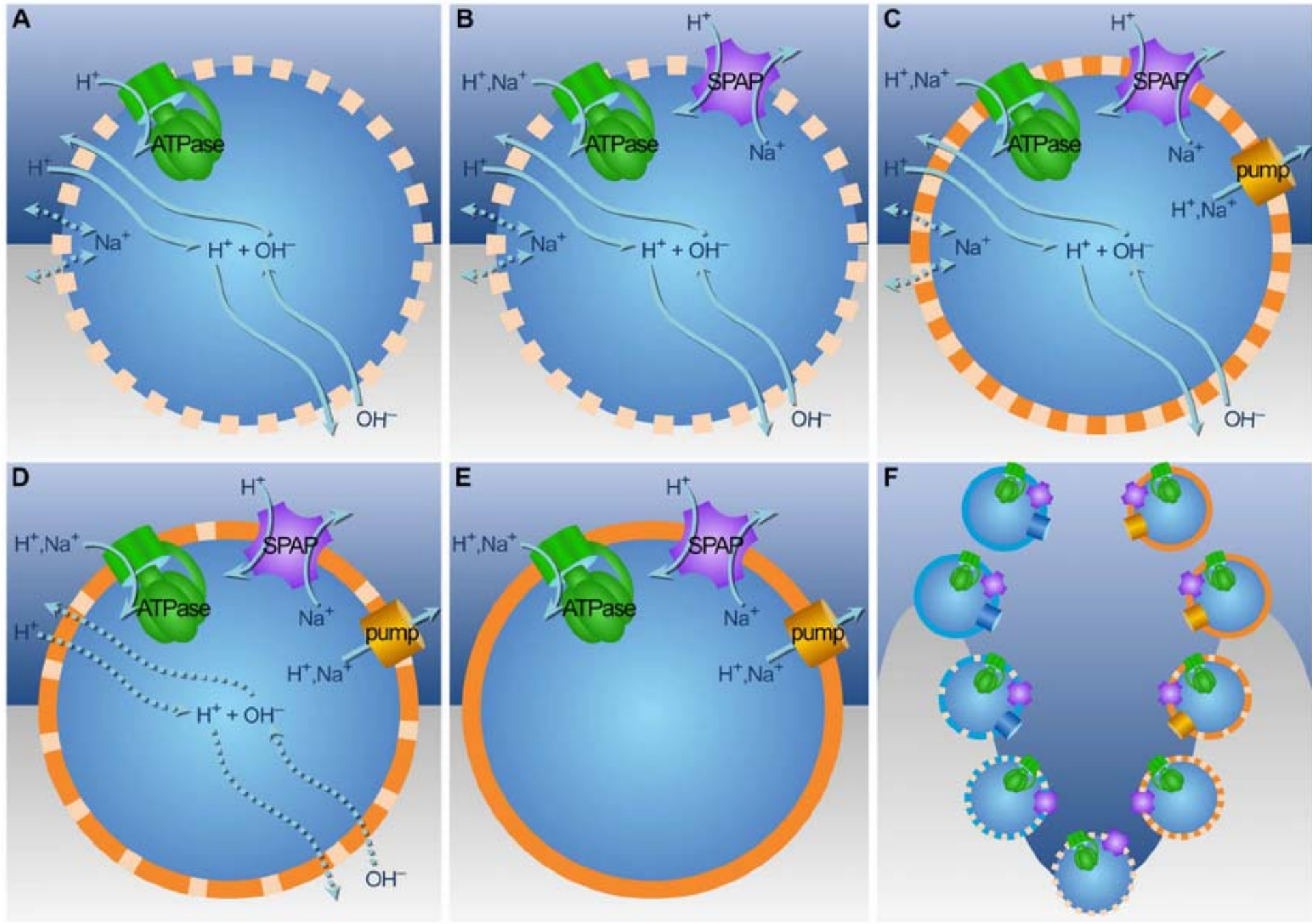


acidic laminar flow (pH 5-7)



alkaline laminar flow (pH 9-10)



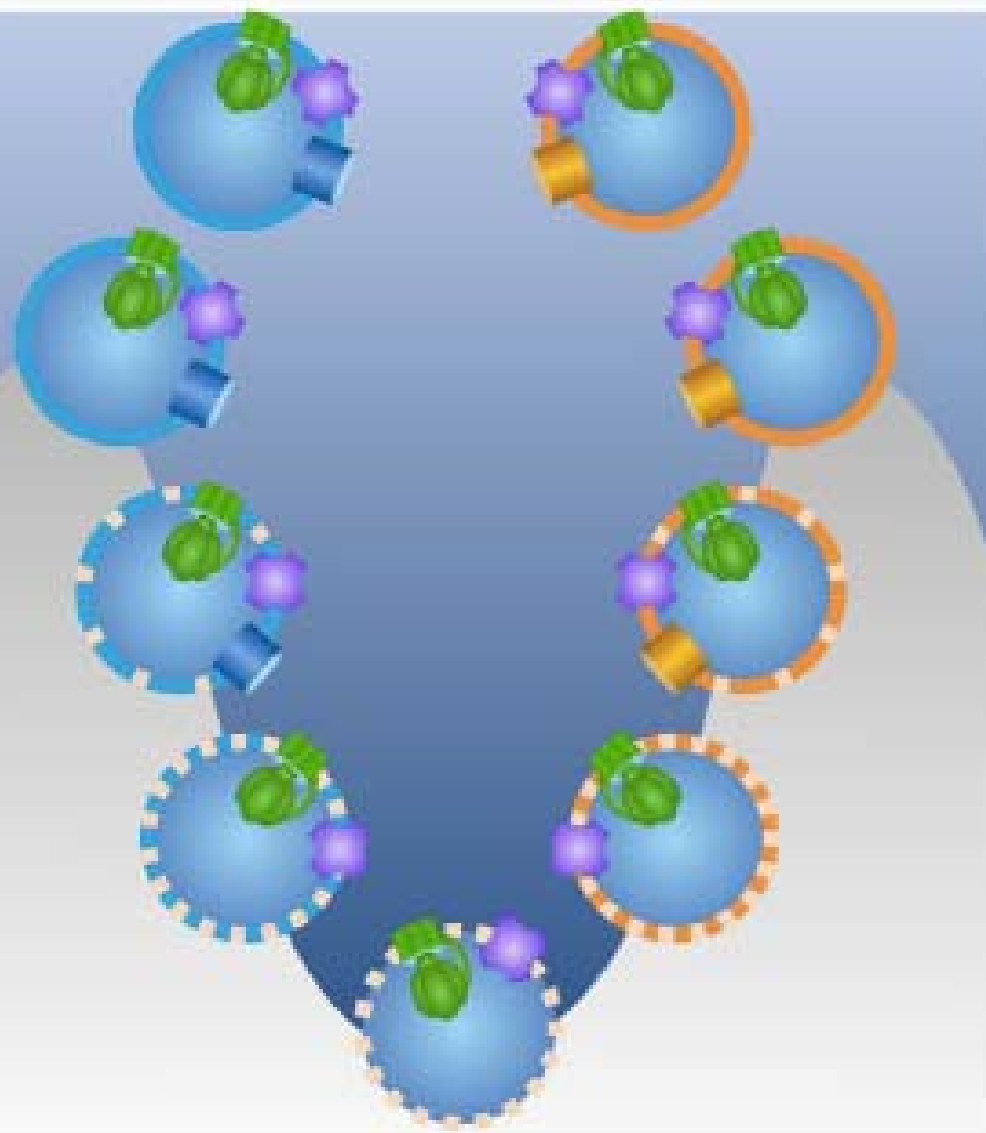


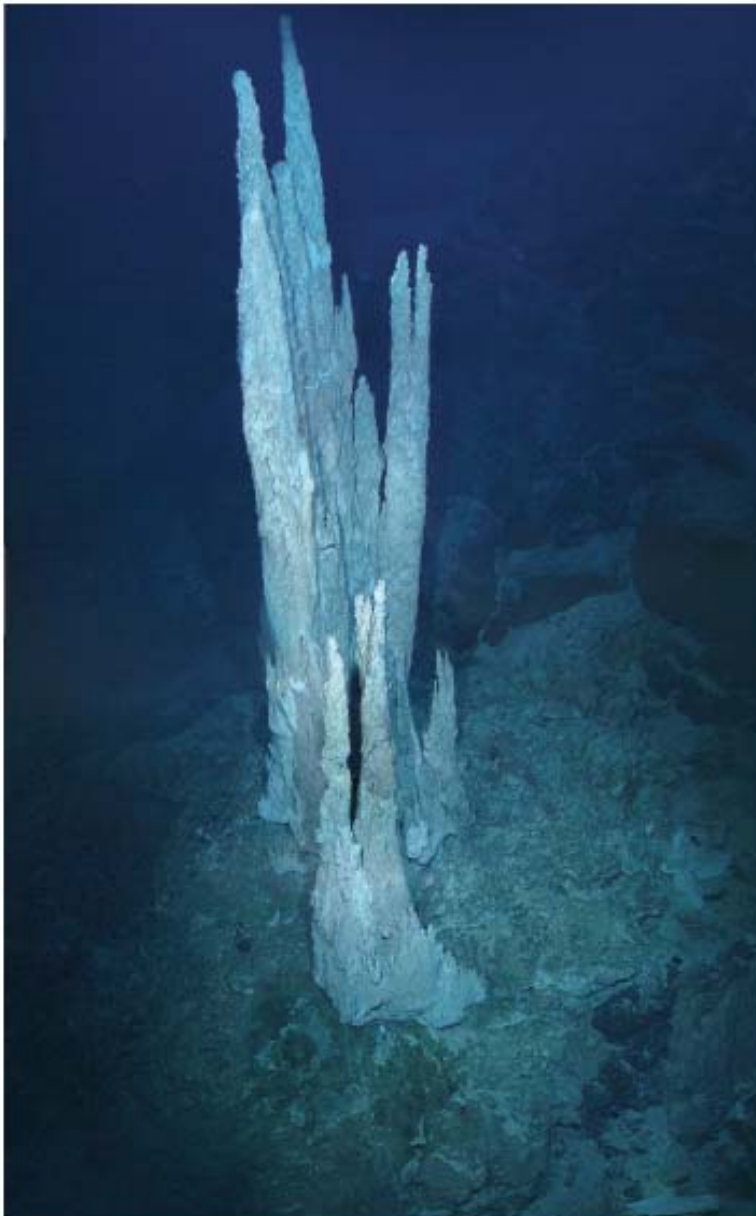
The diagram illustrates the cellular response to acid-base imbalance. Panel A shows baseline activity of ATPase and Na⁺ transport. Panel B shows the addition of SPAP, which inhibits ATPase. Panel C shows the addition of a pump that transports H⁺ and Na⁺ out. Panel D shows SPAP also inhibiting the pump. Panel E shows the removal of SPAP, restoring ATPase activity. Panel F shows the overall cellular response with multiple cells.

archaea

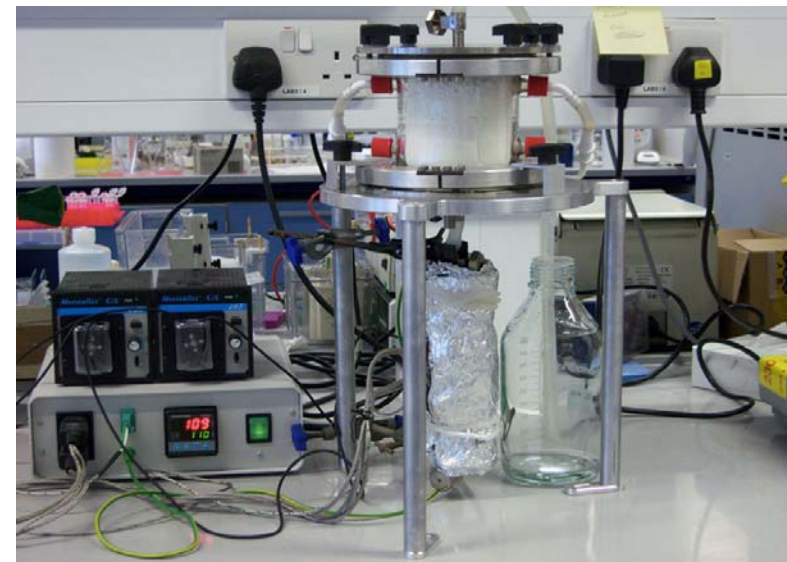
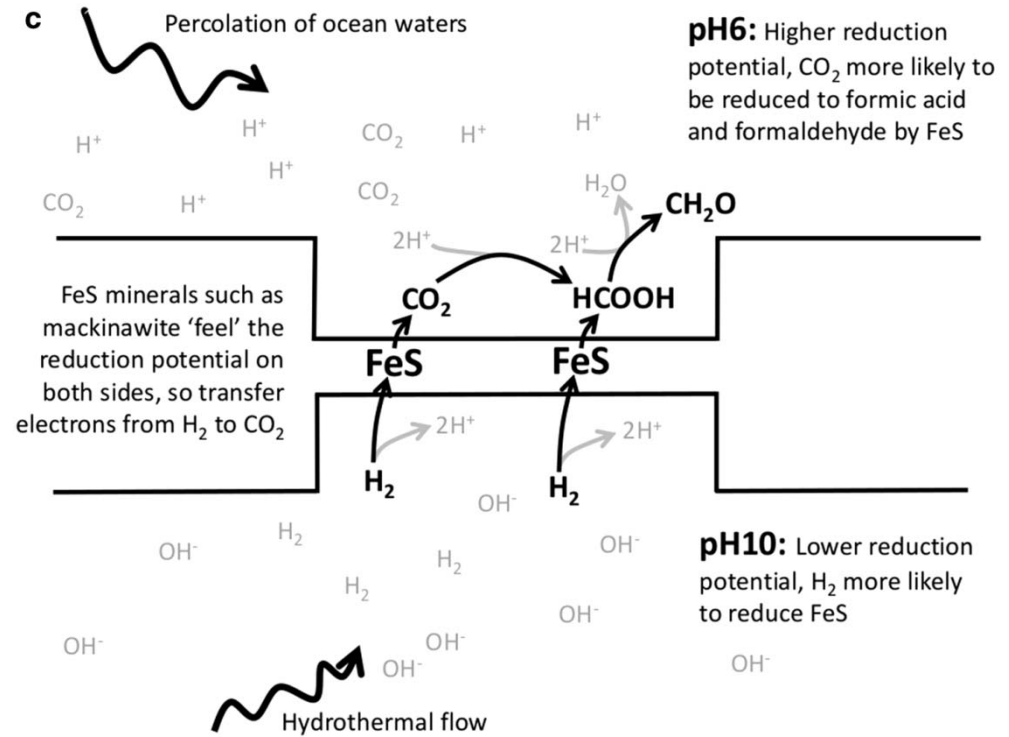
bacteria

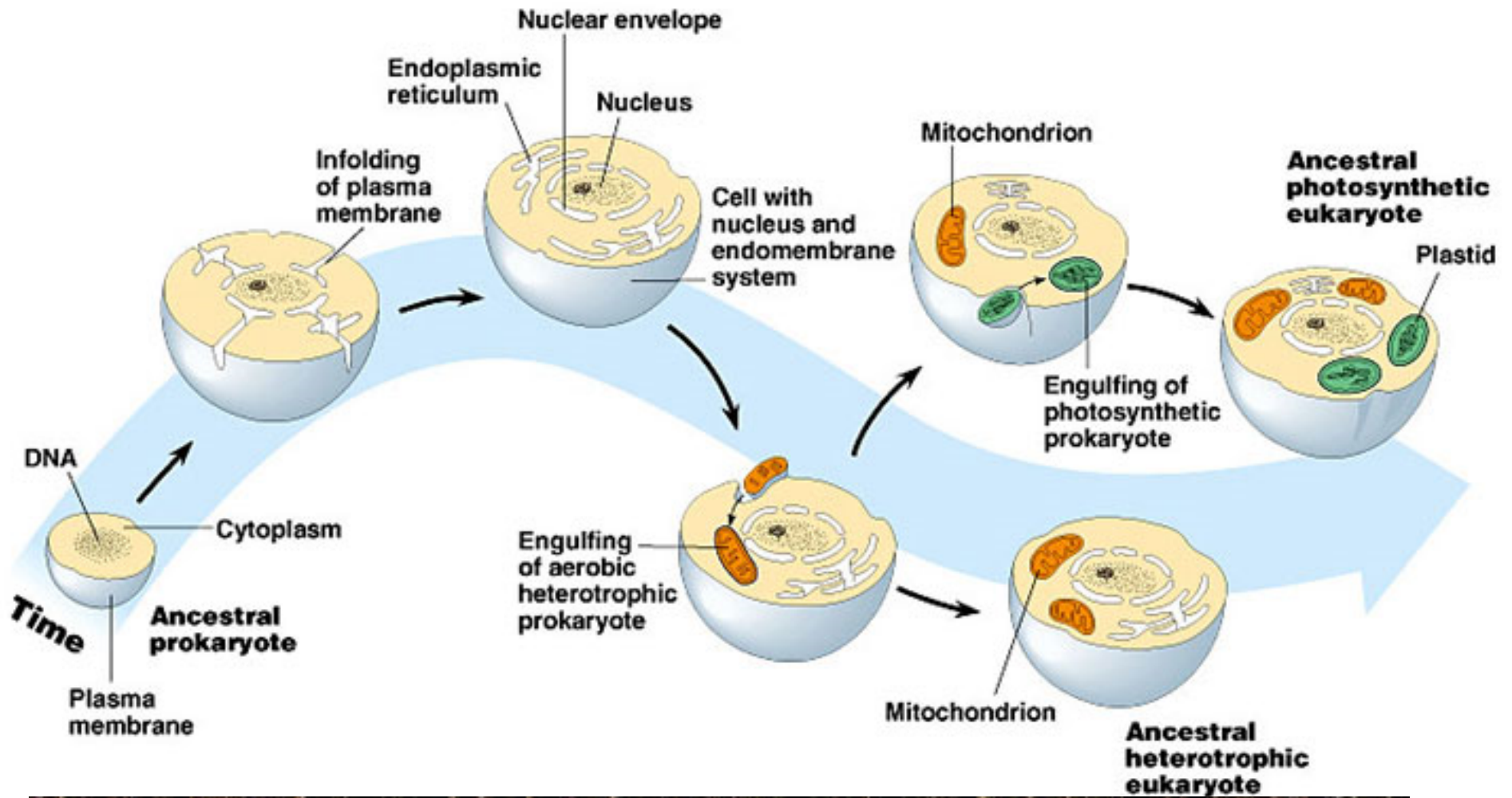
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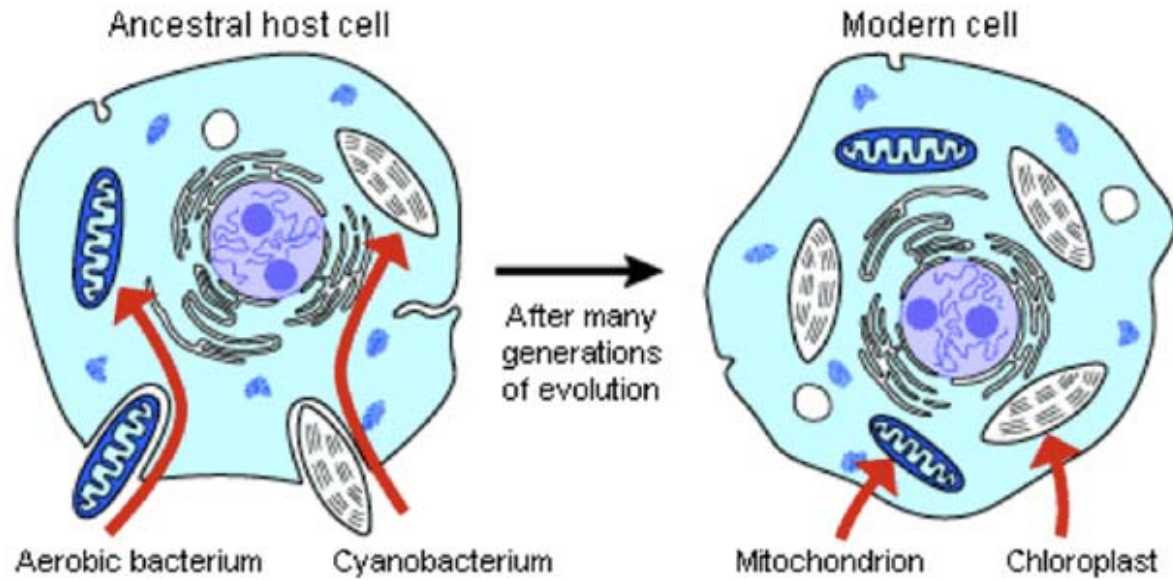


Clues to where life evolved. Similarities between bioenergetic processes and those at hydrothermal vents such as Lost City suggest that life may have evolved at such vents on the early Earth. This photo was taken at Lost City in 2005 using the remotely operated vehicle *Hercules*.





The Origin of Eukaryotic Cells



Lynn Margulis
(1938 – 2011)

