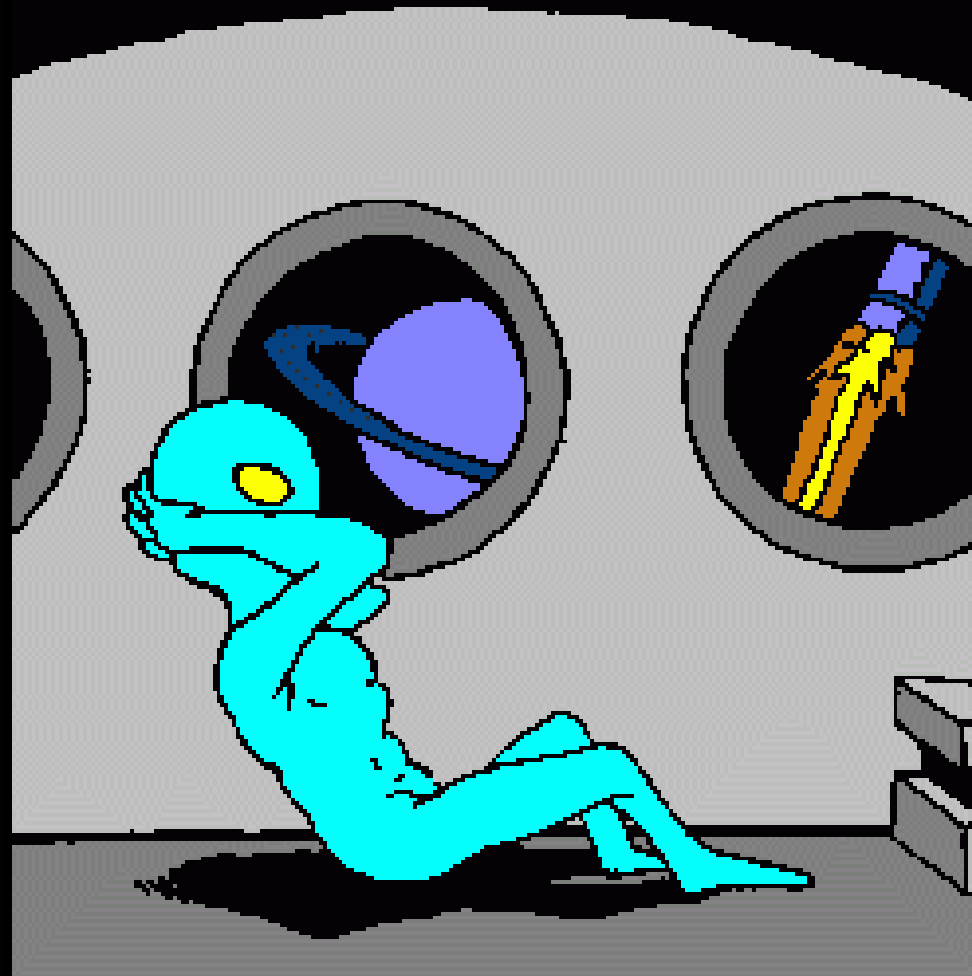


ASTR 380
The Origins of Life on Earth



ALIEN ABDUCTION

Mid-term: October 11



The Colonisation of Space.

Review Session:

Wednesday 2:30 pm here



The Origins of Life on Earth

The background of the slide is a composite image. At the top center, there is a view of Earth from space, showing the blue and white atmosphere and the brownish-green landmasses. To the right, there is a bright, glowing yellow sun. The bottom half of the image shows a dark, reddish-brown, rocky surface, possibly a planet or moon, with some lighter-colored patches.

Working back from today
The most basic components
How DNA and RNA work
Working forward from simple molecules
Bridging the gap

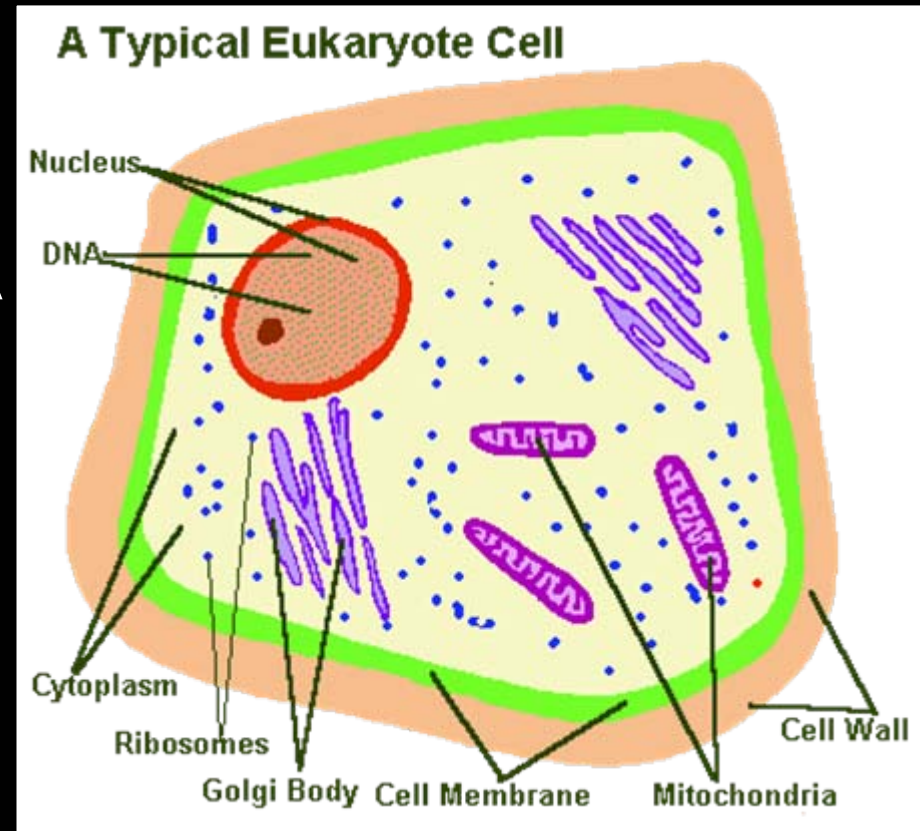
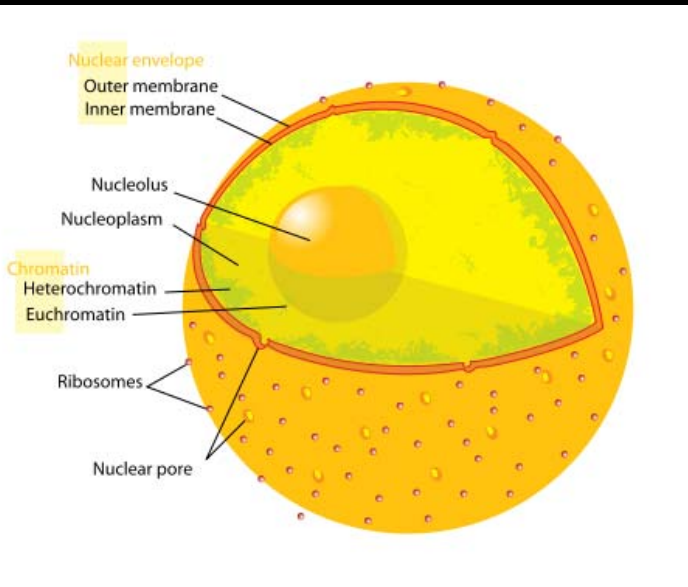
I hope to convince you that life cannot possibly exist!

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What is the simplest form of life that exists today?

A eukaryote cell contains:

Nucleus – double walled cell within cell containing DNA
DNA – genetic material.
Blueprints for cell



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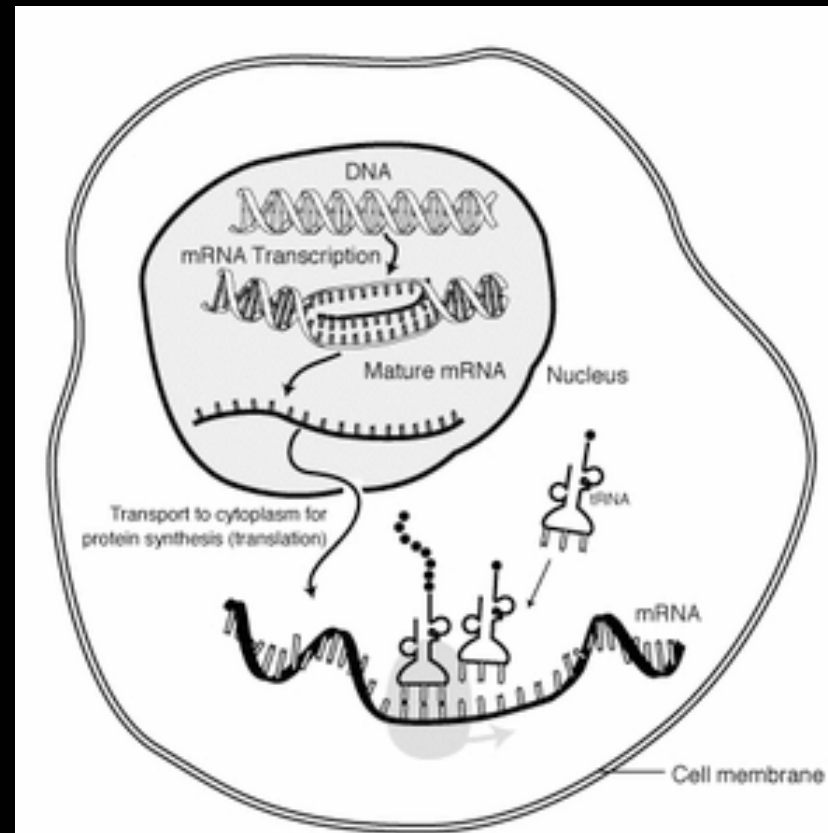
RNA world in eukaryote cell

mRNA – messenger RNA is copied from part of the DNA and contains the blueprint for a protein

tRNA – delivers amino acids to ribosomes for building proteins

rRNA – ribosome RNA which does the decoding of mRNA

Ribosomes – structures of RNA and proteins which build proteins from amino acids delivered by transfer RNA

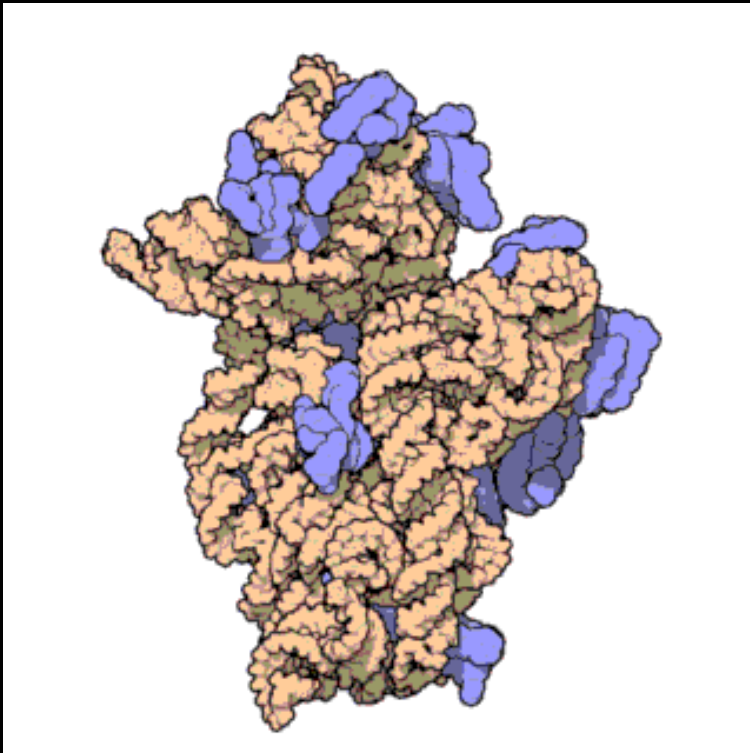


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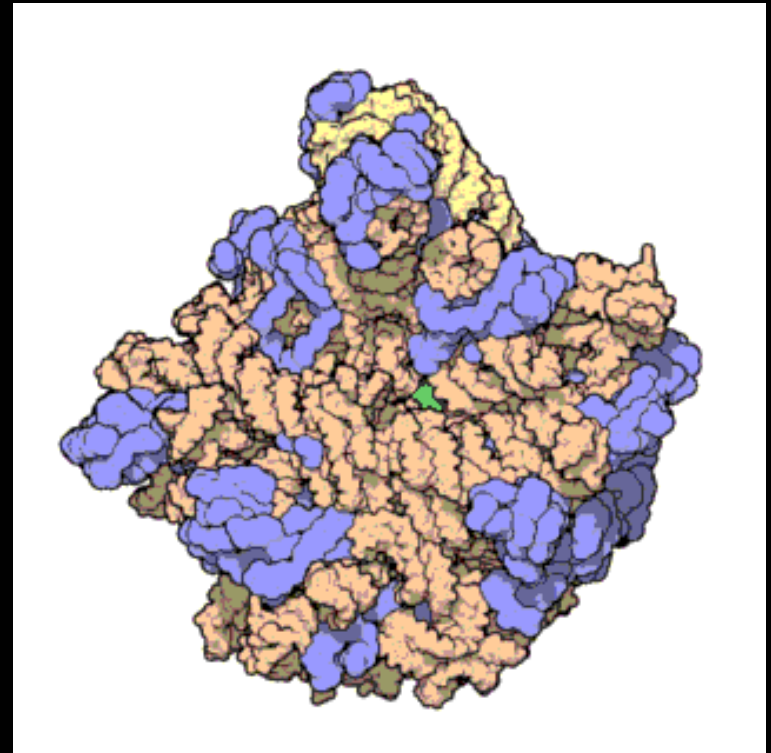
RNA world in eukaryote cell

Proteins are build intertwined with RNA to create the correct structure.

Protein in blue



RNA in orange/yellow



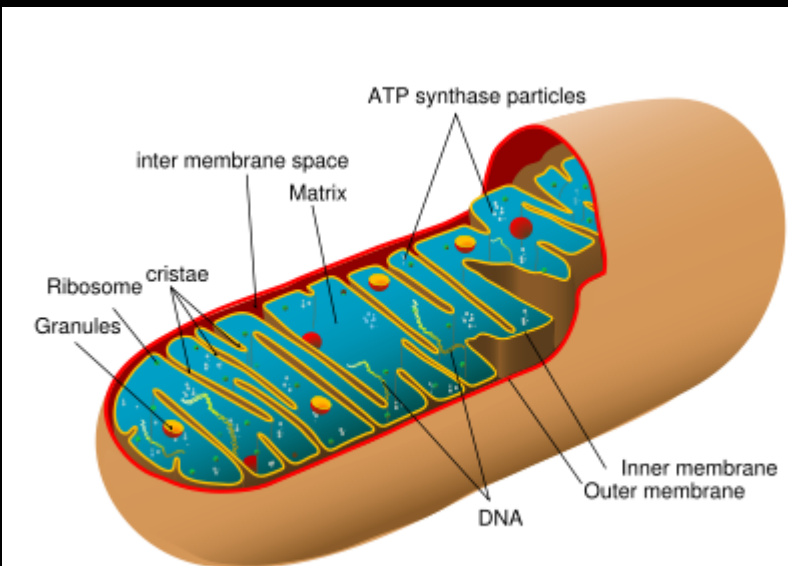
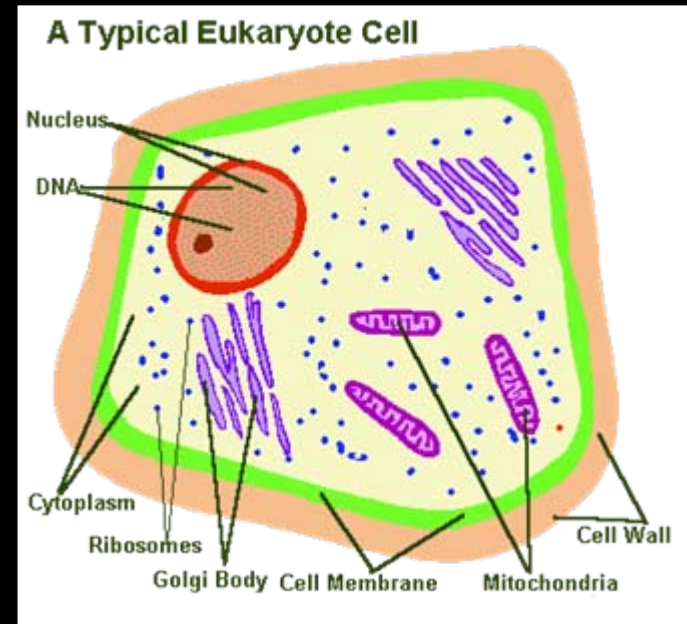
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A eukaryote cell contains:

Golgi body – packages proteins and lipids for use and delivers them around cell.

Mitochondria – separate cell which may be descendant of free living prokaryote with independent DNA.
Now the power supply.

Produces ATP from glucose and oxygen

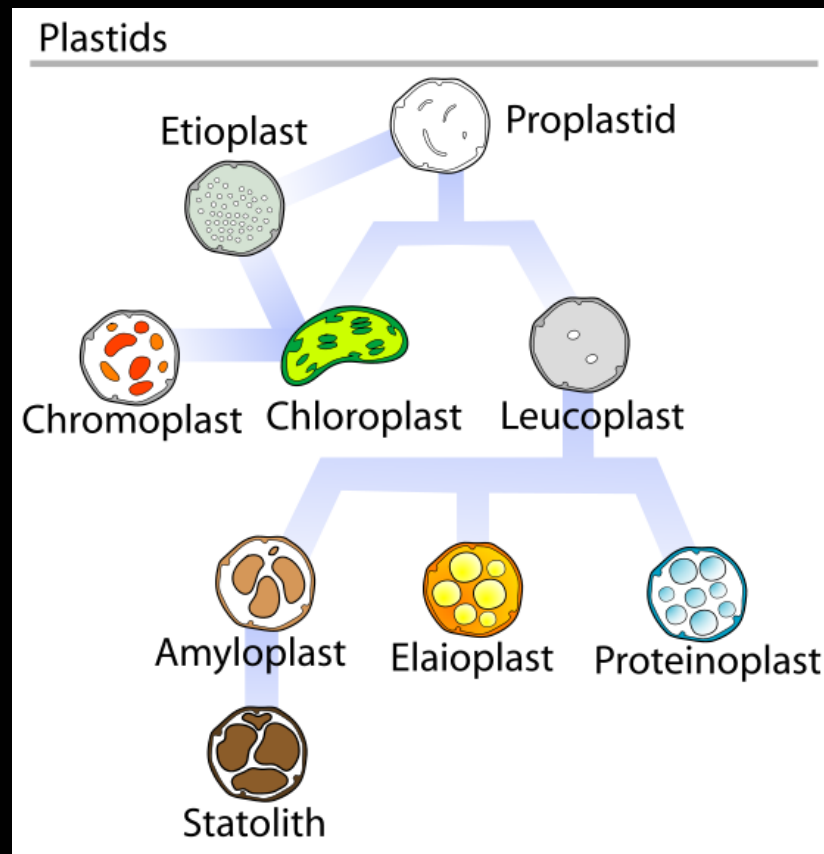


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A eukaryote cell contains:

Plastids – present in plants

do the photosynthesis and other essential tasks
separate DNA but dependent on cell DNA also

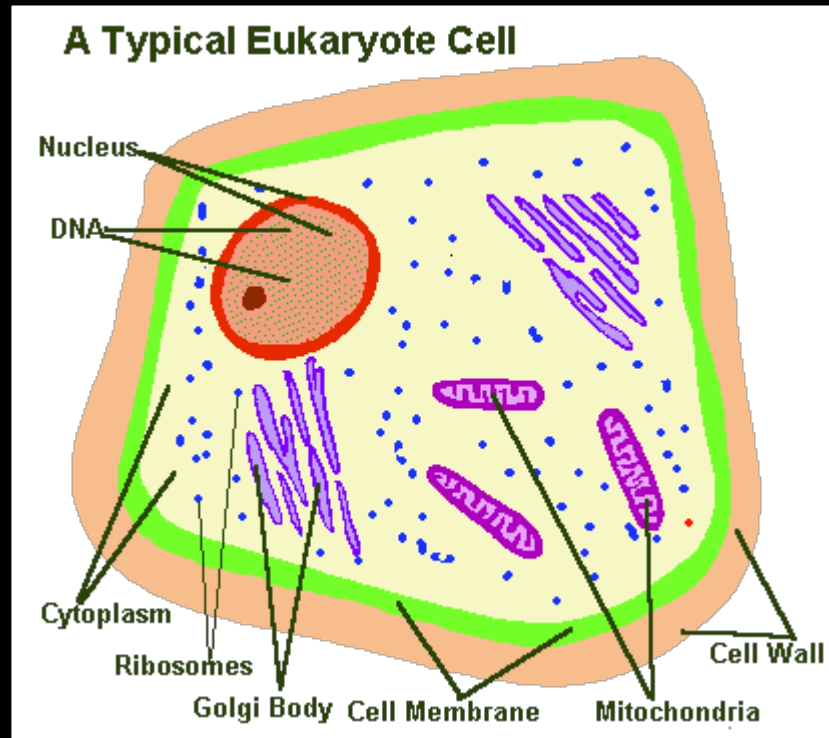


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A eukaryote cell is a complex of cells within cells.

Not a good place for life to start.

It rather looks like a chop-shop where all sorts of useful creations were brought together under one roof!

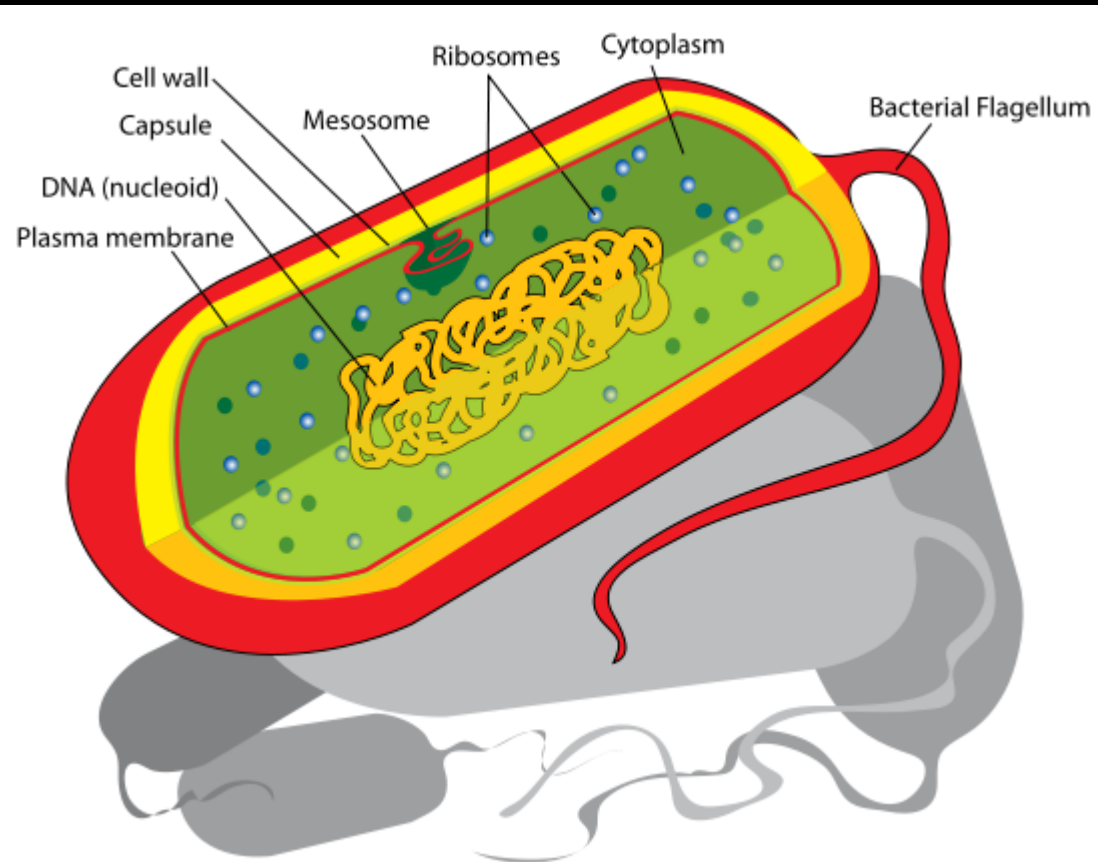


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A prokaryote cell contains:

DNA without a nucleus which is generally a single circular loop – with no wasted coding

Ribosomes and RNA system to create proteins



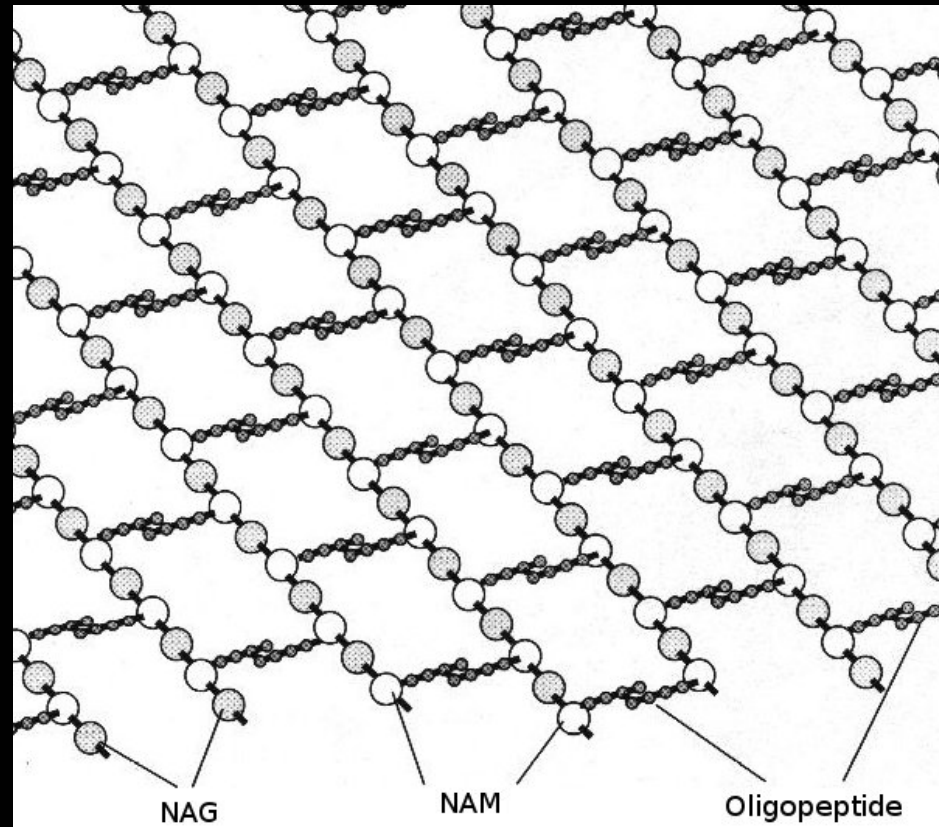
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A prokaryote cell:

Cell wall is a lattice structure of sugars and amino acids

The role of the Golgi body and the mitochondria occur at the cell wall.

Very clearly more primitive than eukaryote cells

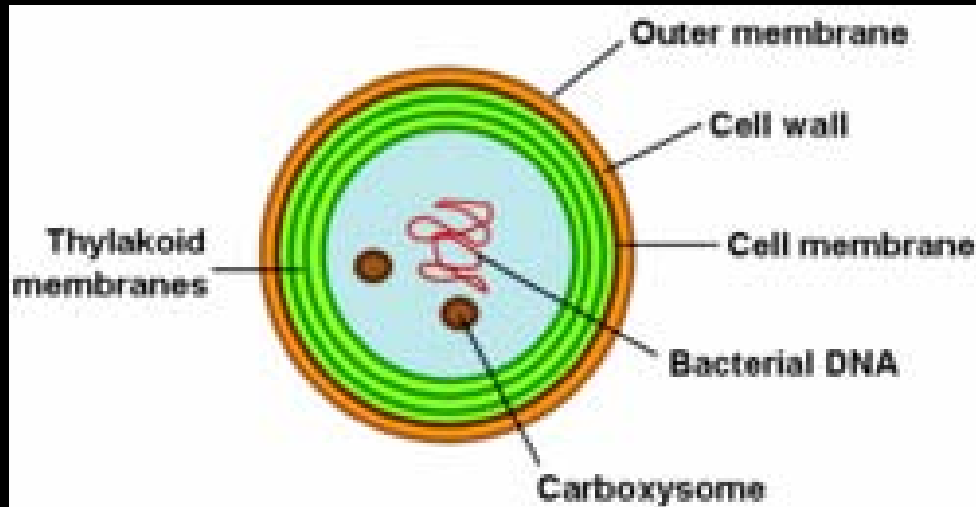


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Cyanobacteria is a prokaryote

Fossil evidence that they lived 3.8 Billion years ago.

photosynthesis occurs within
Thylakoid structures – green
below

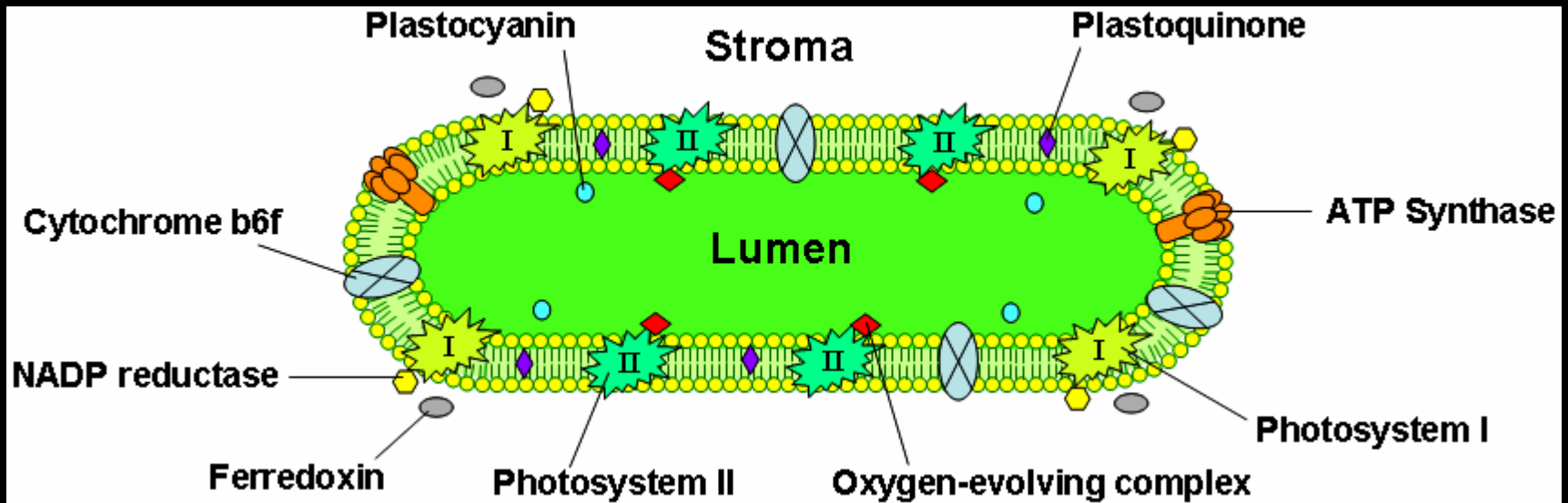


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Cyanobacteria

Thylakoid structure is a complex structure which contains at least 335 different proteins...

Simplier but not so simple....

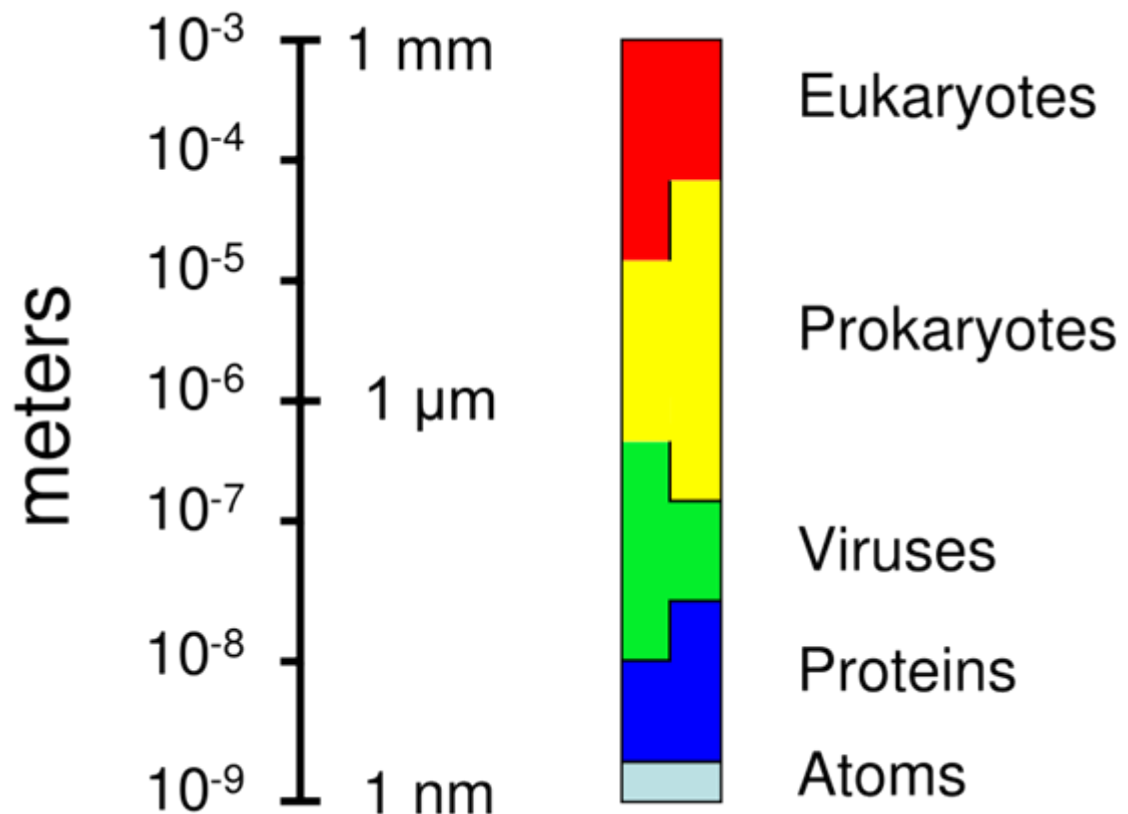
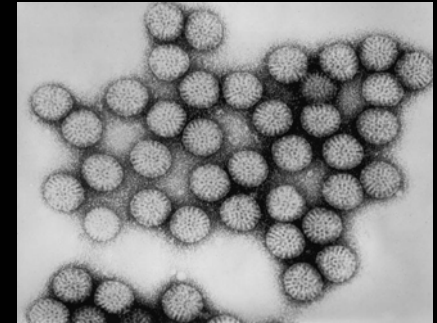


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What about virus?

Smallest form of “life” – if considered life

Genetic material is
DNA or RNA



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What about virus?

RNA – genetic material and blueprints for all parts

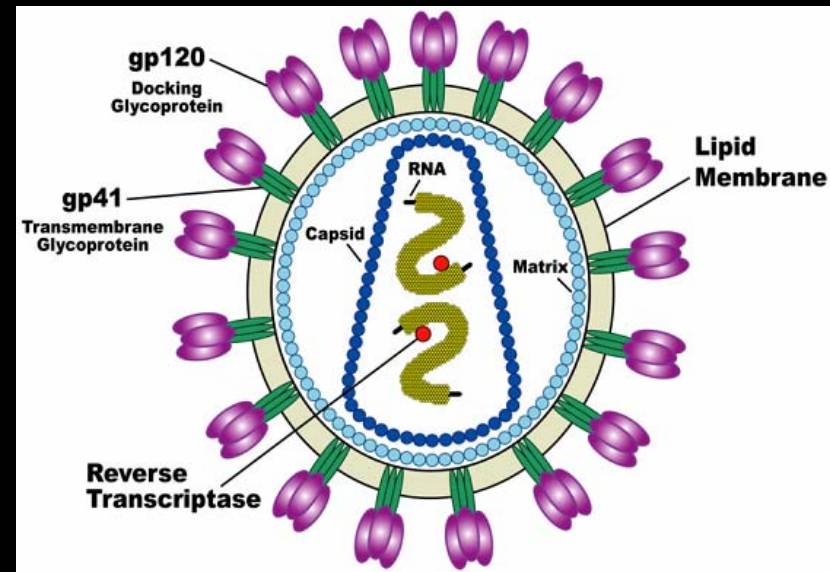
Reverse Transcriptase – enzyme which translates a single strand of RNA into DNA

Capsid – protein coating for RNA

Lipid Membrane – bilayer of lipids that further protect virus serves as sites for receptor proteins

receptor proteins – proteins stuck on the surface to assist in cell entry

a wolf in sheep's clothing

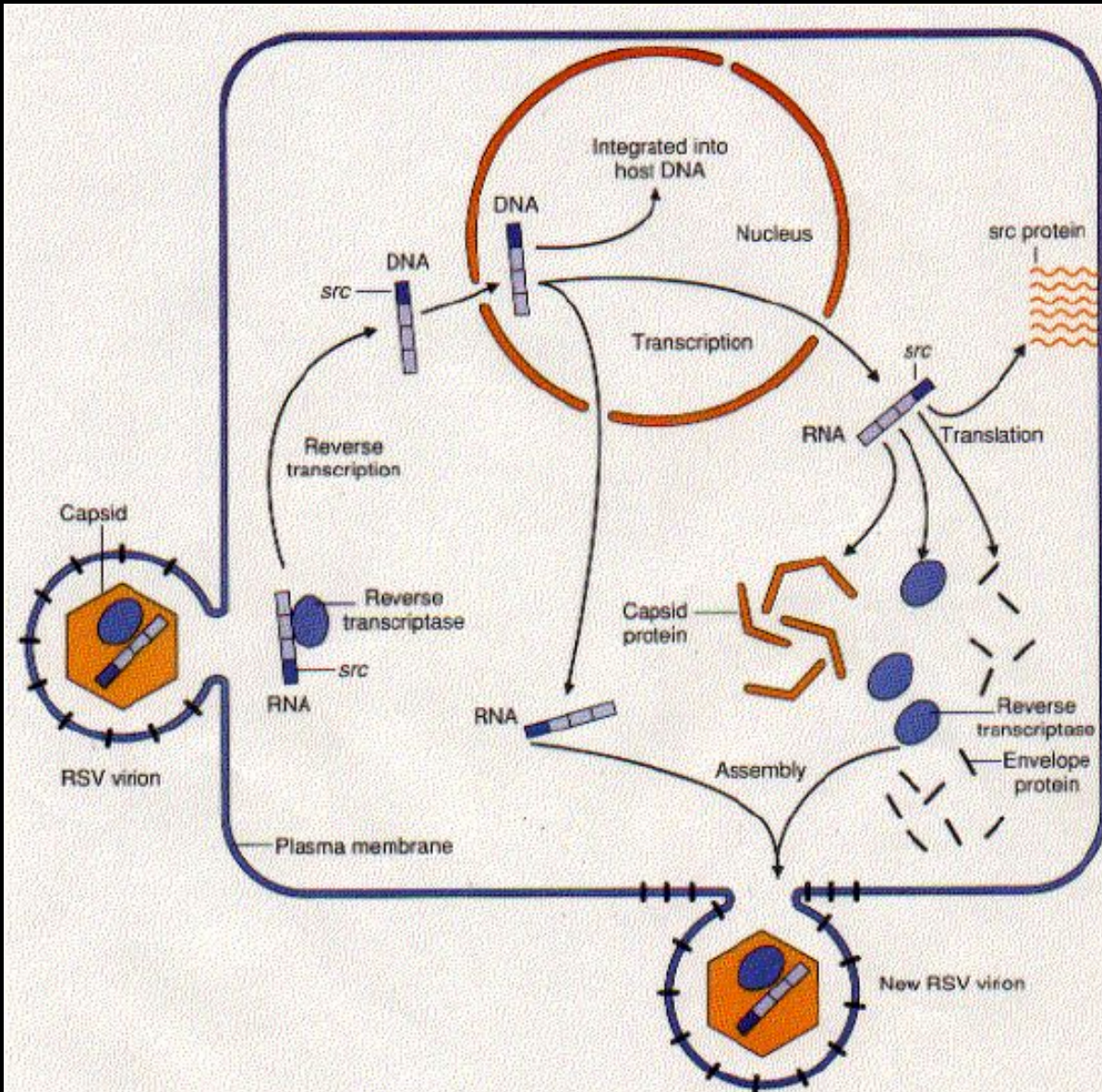


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Live Cycle of a Virus

And here-in lies the rub.... A virus is dependent on hijacking the DNA of the host cell to reproduce..

Which is the chicken and which is the egg....



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RNA World Hypothesis:

Hypothesis that RNA were the first self-reproducing molecules.

They were capable of making themselves and proteins

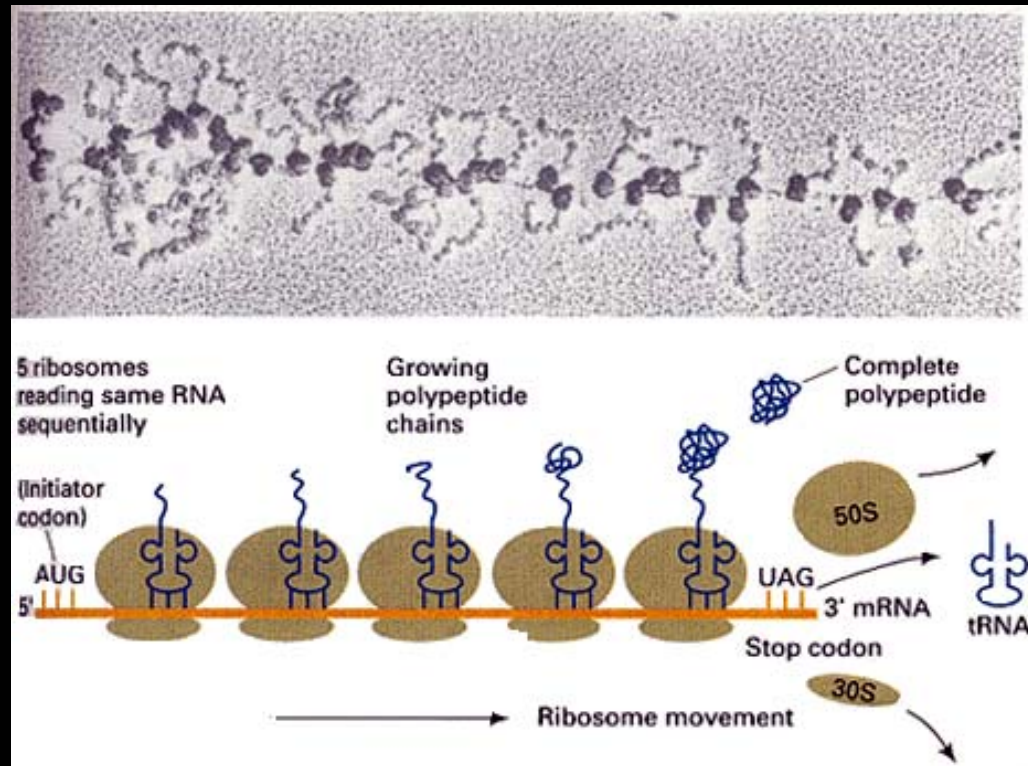
Later evolved to make DNA, and later evolved into a DNA dominated world.

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RNA World Hypothesis:

In this hypothesis, ribosome RNA is considered the most primitive form.

Even though it now works on mRNA from the cell DNA

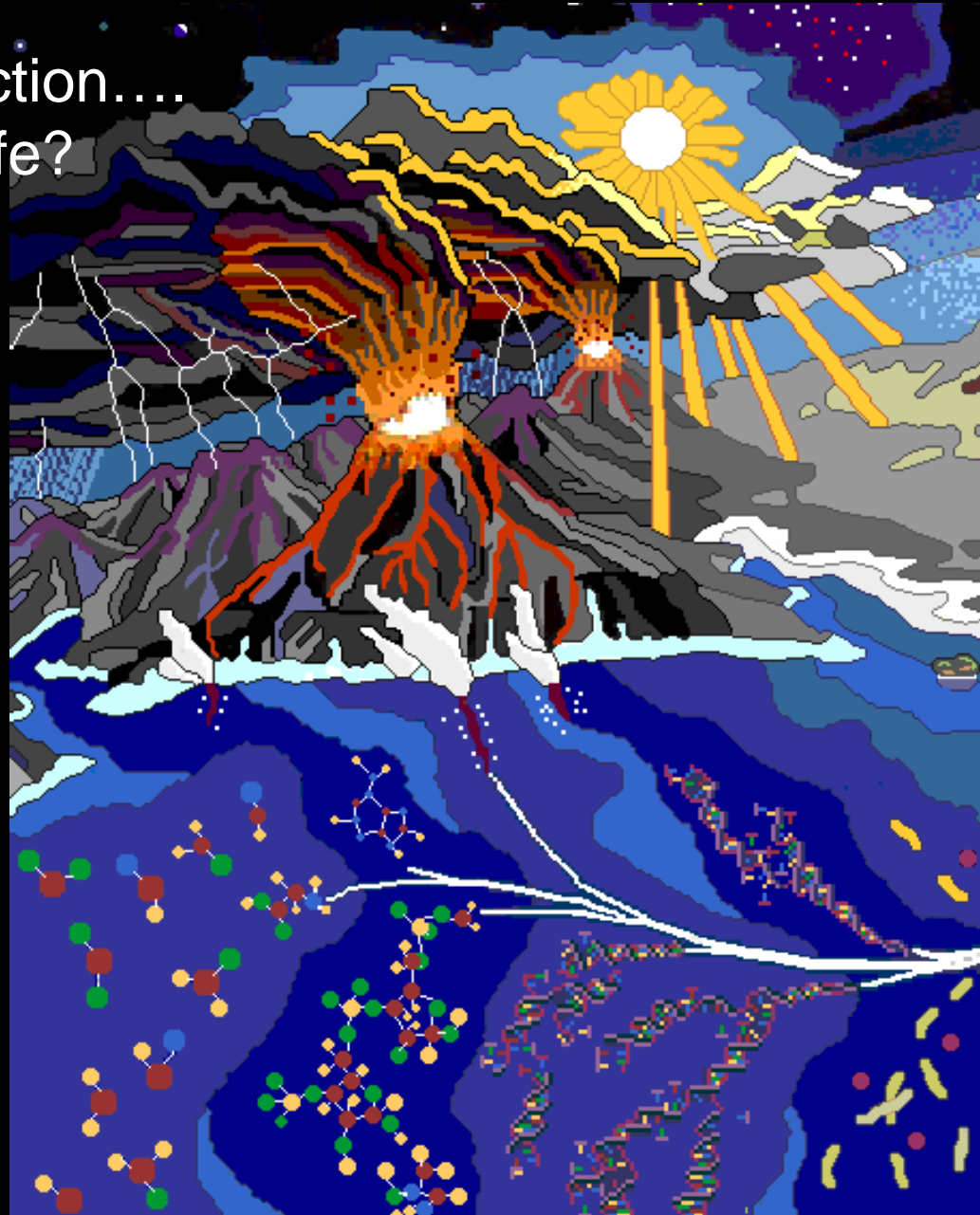


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Working in the forward direction....
From simple molecules to life?

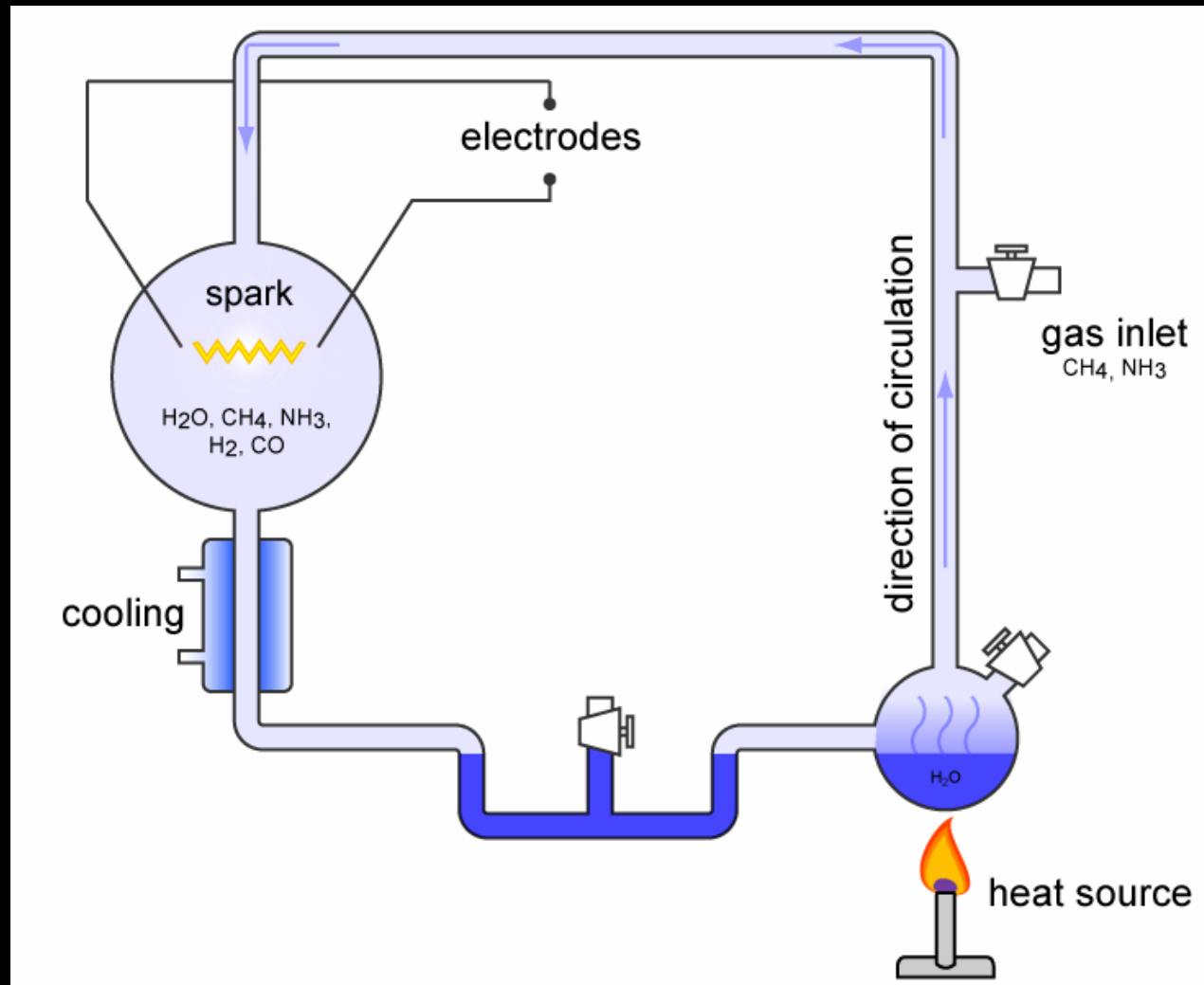
We know a lot about the
conditions on the Earth
4 Billion years ago.

liquid water
carbon dioxide
methane
ammonia
hydrogen
light
geothermal energy



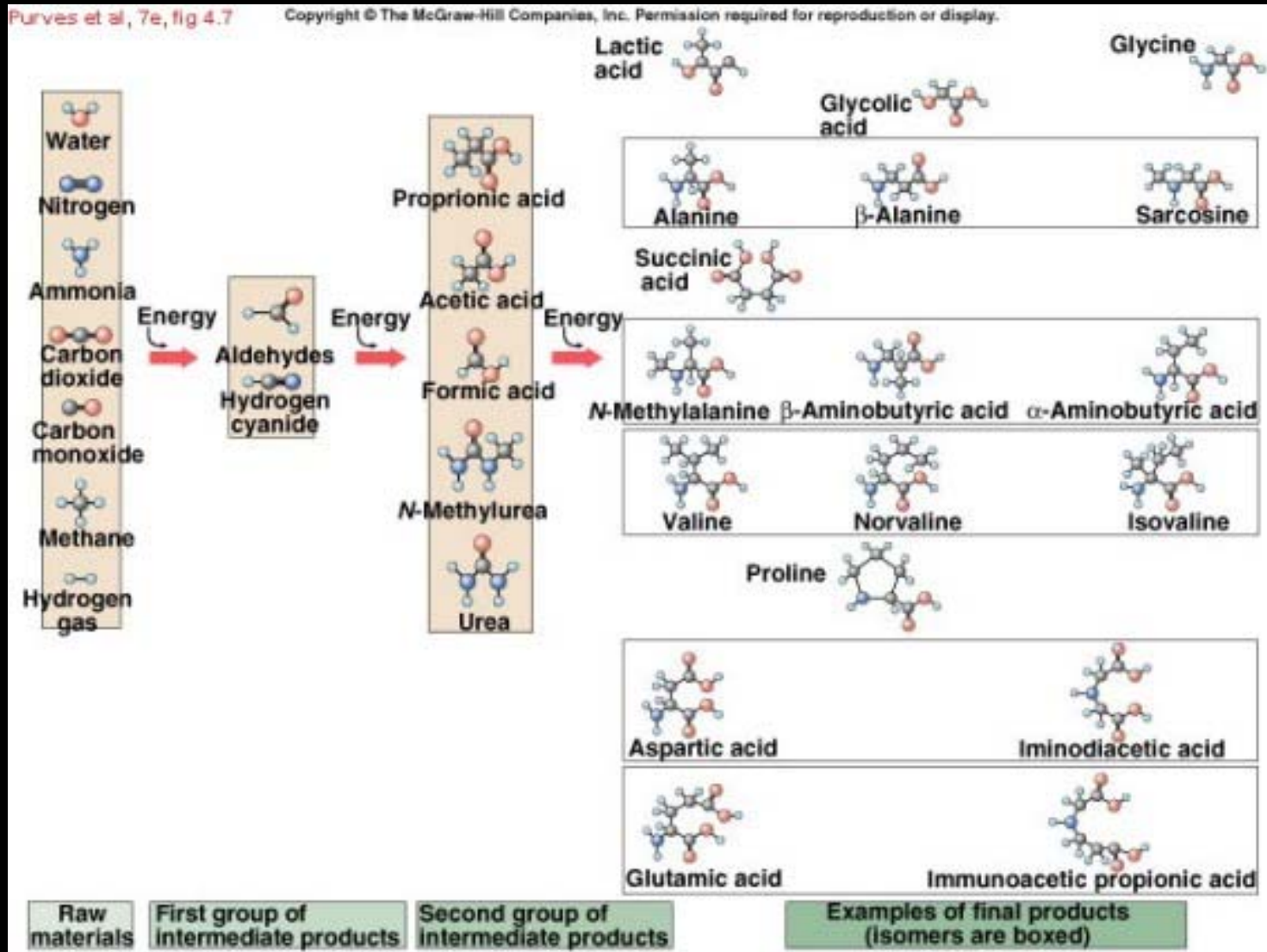
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Miller Urey Experiment – showed that complex molecules can be made with simple chemical reactions



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Miller Urey Experiment



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Continuing extensions of the experiments with best estimates of the early Earth's atmosphere continue at a modest level.

Experiments can produce amino acids, sugars.

No experiment to date has produced self-replicating molecules.

All of the chemistry is driven by the energy input in the form of "lightning" or light.

Biological and non-biological molecules (wrong-handed) are produced in these experiments.

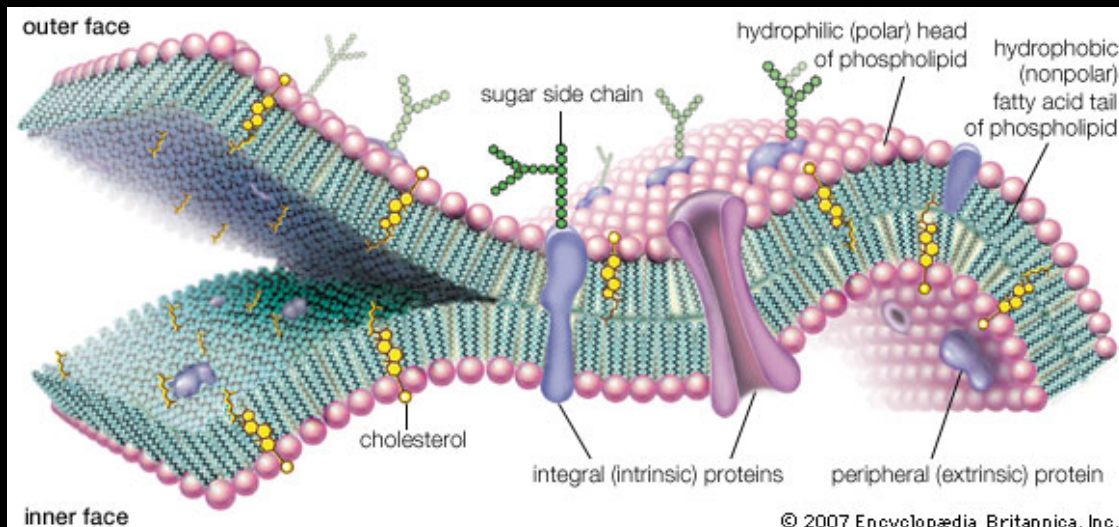
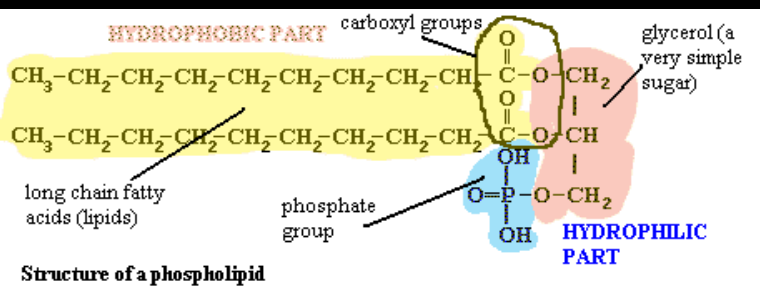
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What is the bare minimum for “life”?

RNA – some molecule complex enough to carry genetic blueprints for the organism.

Cell wall – something to protect the RNA from the raw environment and contain replication

A rich organic soup of less complex molecules to “eat”



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What is the bear minimum for “life”?

Perhaps the first “life” include the concept of a cell....

The RNA reproduced when the soup was concentrated enough... for whatever reason....

The step to RNA is huge.

We don't know how it happened!

