12.3 Origin of Life

I. Age of the Earth

- There have been many hypotheses of Earth's origins.
- The most widely accepted of Earth's origins is the ***nebula hypothesis.***
- Scientists estimate that the earth is about ***4.6 billion*** years old.

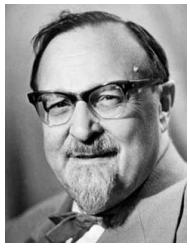
II. Life Origins: The Modern Idea

- **Biologists *accept*** the concept that **microorganisms do not simply come from the air, but from other living organisms, or *Biogenesis***. However, this idea does not answer the question…. ***How did life begin on Earth***?

A. Formation of Simple Organic Molecules

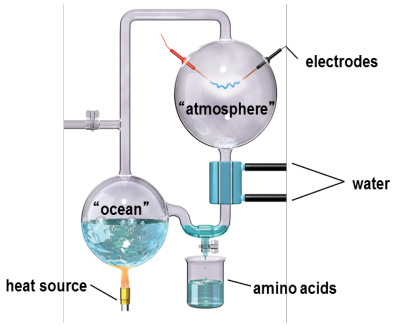
1. Simple ***organic*** molecules preceded life on Earth (molecules that contain carbon)…which lead to ***complex*** molecules (protein, carbohydrates, and nucleic acids) … Essential to ***life***!

2. Earth's early atmosphere - No free ***Oxygen***
   a. Consisted of water vapor, ***nitrogen***, methane, and ***ammonia***.
   b. In the 1930's, Alexander ***Oparin*** - hypothesized that life began in ***oceans*** (Energy from the sun, lighting, and the Earth's heat triggered chemical reactions to produce small ***organic*** molecules from the substances in the atmosphere)…and the rain washed them into the oceans, to what is often called ***primordial soup***.



c. In 1953, Stanley ***Miller*** and Harold ***Urey*** simulated the conditions of early Earth in their laboratory, ***supporting*** Oparin's hypothesis.

*The simulation included running an electric current (lighting) through gases similar to early Earth and this did produce organic molecules, includng amino acids.



Harold Urey & Stanley Miller

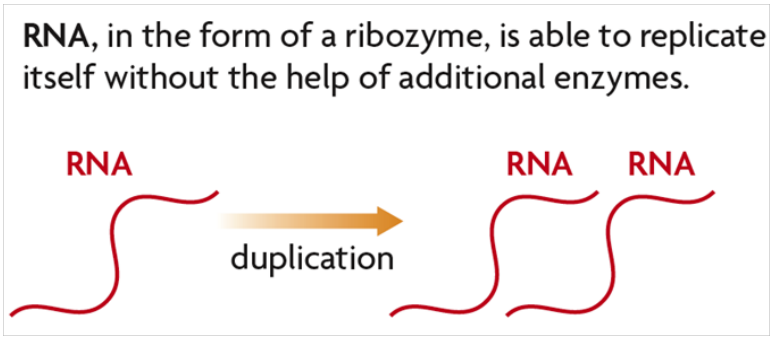
II. There are different hypotheses of early cell structure.

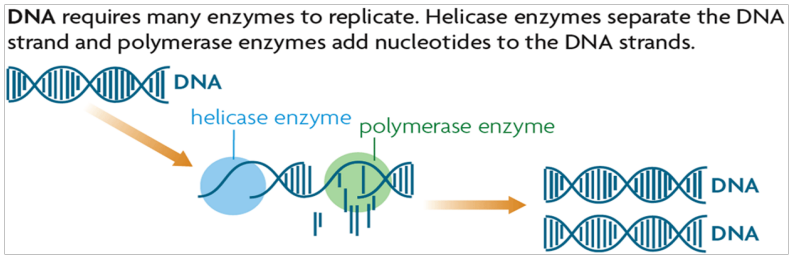
- A RNA World hypothesis proposes that ***RNA*** was the first genetic material.

  -In the 1980's **Thomas *Cech* & Sidney *Altman*,** independent of each other, discovered:

  *__*Ribozymes*__ are RNA molecules that catalyze their own replication.

  *DNA ***needs enzymes*** to replicate itself.



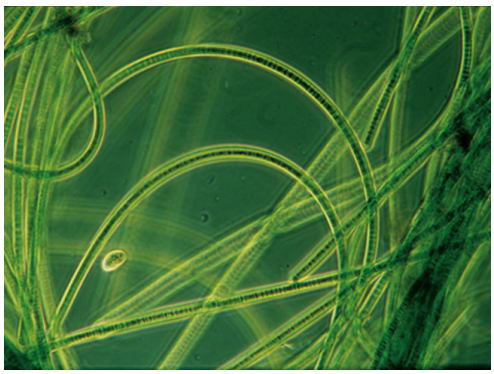


Section 12.4 - Early Single Cell Organisms

- The oldest fossils known have been found in Precambrian rocks and are around **3.4 billion** years old.
- These fossils resemble modern day species of **photosynthetic cyanobacteria**.
- Even today, in Western Australia you can find living representations of large masses of cyanobacteria, called **stromatolites**

I. Microbes have changed the physical and chemical composition of Earth.

- The oldest known fossils are a group of marine cyanobacteria.
  1. ***prokaryotic cells***
  2. ***added oxygen to atmosphere***
  3. ***deposited minerals***



II. Evolution of cells

A. The first true cells

1. ***Fossils*** indicate that about ***3.4 billion*** years ago, photosynthetic prokaryotic ***cells*** existed on Earth, but were not the earliest cells.
2. The earliest cells were probably prokaryotic cells that evolved from a **proteinoid microspheres**, and were most likely ***anaerobic*** heterotophs.

3. The first ***autotrophs*** were archaebacteria. Because of ***competition*** among other heterotrophs, ***chemosynthetic*** archae (a prokaryote), living in harsh environments evolved.
   i.e. deep sea vents and hot springs.

Chemosynthesis = the ability to break down ***inorganic*** molecules into ***organic*** molecules needed to feed.

B. Photosynthesizing Prokaryotes

1. A product of photosynthesis, ***oxygen***, was produced, and therefore the Earth's atmosphere ***increased*** in its amount of oxygen.

2. ***Organisms*** that respire aerobically would have evolved and thrived.

3. ***Diversity*** in life of prokaryotic cells increased, according to the fossil record, about ***2.8 billion*** years ago.

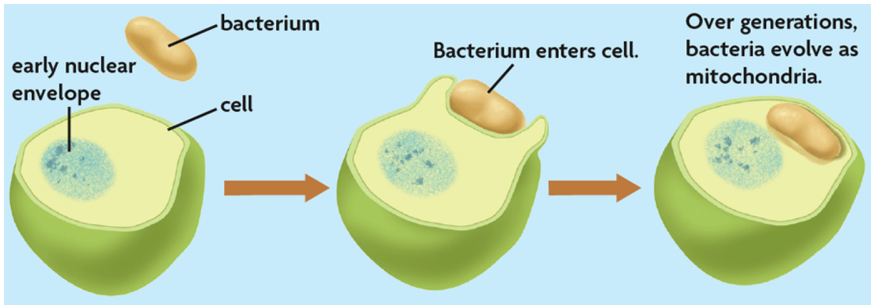
C. The Origin of Eukaryotic Cells

1. In the 1960's, Lynn ***Margulis***, an American biologist, proposed how eukaryotic cells ***evolved***.

2. **Endosymbiont Theory -** proposes that approximately 1.5 billion years ago tiny prokaryotic cells were "***swallowed***" by larger cells but were not digested.

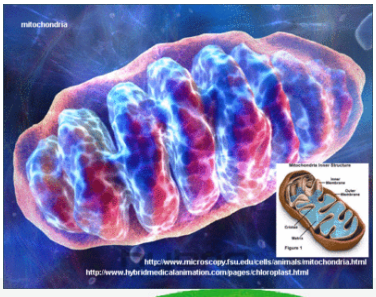
The prokaryotic *"**trespassers**"* remained inside the larger cells, gradually losing the ability to live ***independently***.

The two cells formed a partership - the trespassers became ***organelles***, thus forming the **first eukaryotic** cells.

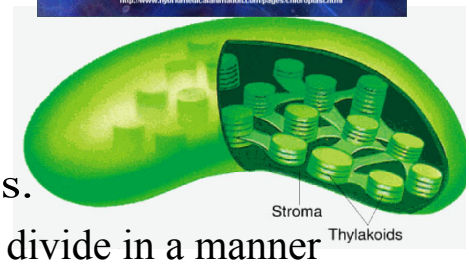


3. Evidence of endosymbiosis theory.

- ***Mitochondria*** today have their own ribosomes and circular strand of DNA.



- The bacteria capable of photosynthesis gave rise to ***chloroplasts*** found in plants and algae and also have own DNA and ribosomes.



- During cell division, these organelles divide in a manner similar to ***bacteria***, prokaryotes.

III. The evolution of sexual reproduction led to increased diversity.

1. ***Genetic variation*** is an advantage of sexual reproduction.
2. ***Sexual reproduction*** may have led to the evolution of ***multicellular*** life.