Biology 10

Chapter 19-3
p 553-558
"Earth's Early History"

## Objectives

- Describe the hypotheses scientists have about early Earth, and the origin of life.
- Describe the theory of how eukaryotic cells formed.
- Explain the evolutionary significance of sexual reproduction.

## Chemical Evolution

- **chemical evolution**- theory that states the _____ _____
- requires several conditions
  - 1) _____
  - 2) _____
  - 3) _____
  - 4) _____
- According to evidence gathered, these four conditions existed early in Earth's history

## Early Earth's Atmosphere

- atmosphere contained $CO_2$, $H_2O$, $N_2$, $H_2$, some $NH_3$, $H_2S$, and HCN
  - satisfies conditions _____
  - early atmosphere was probably _____!
- As Earth cooled, _____ condensed in the atmosphere, and torrential rainfalls appeared
  formed oceans- salt due to erosion of land
  - lots of _____, oceans were probably brown!

## Energy Requirement

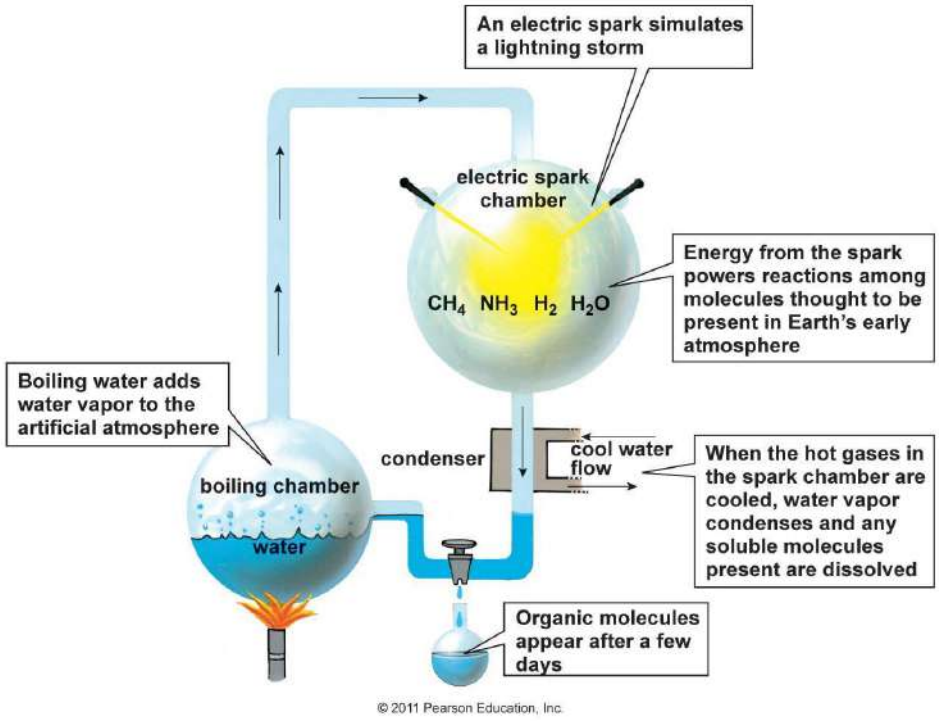
- Energy existed in several forms—satisfied condition 2
- _____ (much more UV than present—no ozone layer!)
- _____
- thunderstorms

## Time Requirement

- Earth estimated to be _____years old
  - satisfies condition 4

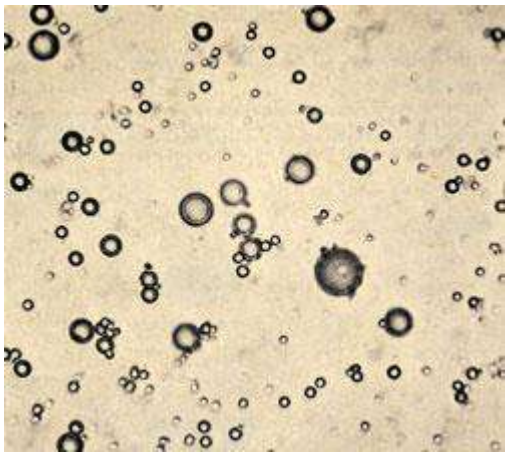
## First Organic Molecules

- 1950's- Urey and Miller designed an apparatus which simulated atmospheric conditions of early Earth
  - after zapping "atmosphere" with electricity, _____ and other organic molecules formed
  - subsequent experiments with different mixtures of gasses have yielded a great variety of organic molecules, including _____
  - Belief is that more complex organic molecules (polymers) may have been formed on rock or clay substrates at the bottom of the ocean




## Formation of Microspheres

- Experiments with _____ clusters of organic polymers, indicate that groups of polymers organize into tiny spheres
- can divide, store energy, and are _____
- hypotheses suggest may have formed living cells 3.8 billion years ago



## Evolution of RNA and DNA

- Scientists still aren't sure, but hypothesize that RNA formed first
- RNA has the ability to
  - 1) _____
  - 2) direct protein synthesis
  - 3) catalyze _____ reactions
- Since DNA is more stable, it may have formed in order to store information more reliably
- Lots of questions left to answer here!

## First cells

- Fossil evidence indicate cells arose _____ years ago
- First cells were _____- do not use oxygen for metabolism
- also heterotrophic, fermenting organic molecules (sugars, amino acids, nucleic acids) as food

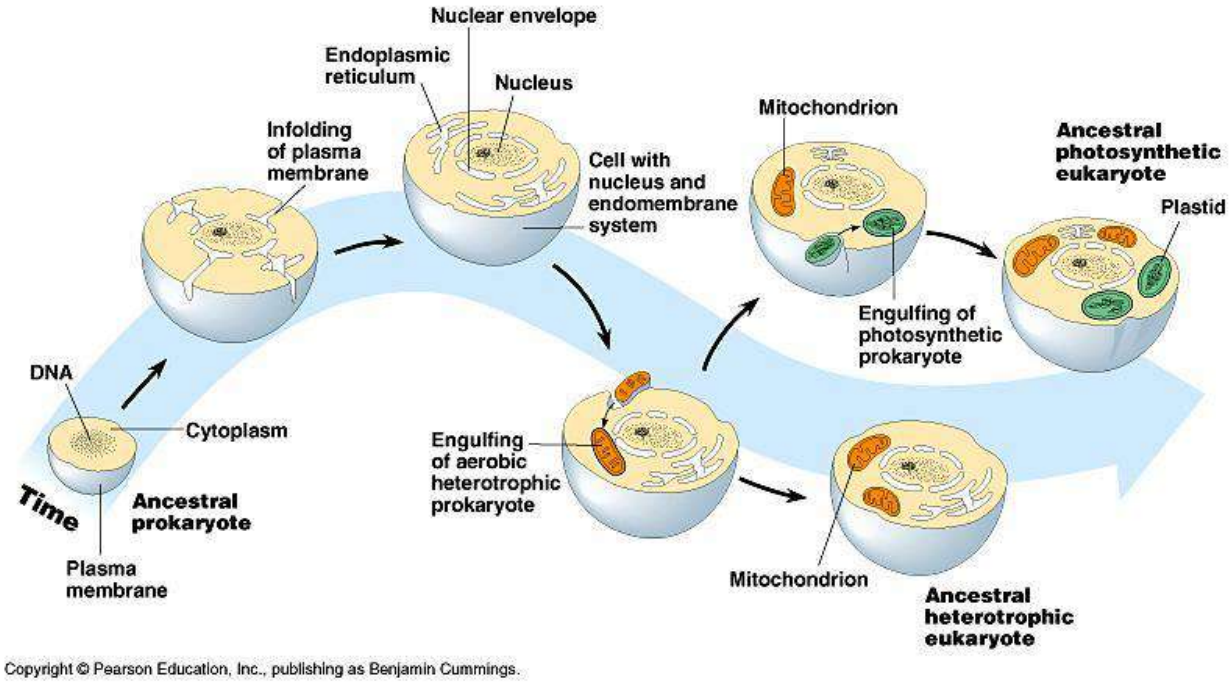
## First cells

- **stromatolites**- columns of fossilized prokaryotic cells 3.5 billion years old
- Next, some cells evolved the ability to _____ for energy (became autotrophs)
  - produced _____, which reacted with iron in the water to form rust bands
  - turned the water from brown to blue
  - eventually began to collect in the atmosphere
  - _____, protecting Earth from UV radiation
  - free oxygen also poisoned many of the first cells, but others were able to adapt and use the oxygen for metabolism (respiration)

## Eukaryotic cells

- occurred between _____ billion years ago
- **endosymbiont theory**- suggests that the first eukaryotic cells arose _____
  _____
  _____
- prokaryotic cells ingested or invaded by heterotrophic cells, but not destroyed
- some could use oxygen to produce ATP, eventually evolved into _____
- later, photosynthetic prokaryotes were ingested, and evolved into _____
- Evidence:
  - chloroplasts and mitochondria resemble prokaryotic cells
  - contain their own _____, prokaryotic _____, and can conduct independent protein synthesis

## Endosymbiotic Theory Image



## Evolution of Sexual Reproduction

- After eukaryotic cells evolved, sexual reproduction evolved
- HUGE step in evolutionary history!
  - sexual reproduction _____ in populations
    - without it, you only have mutations to introduce new variants
  - gives natural selection more “raw material” to work on
  - increases the chances a species will survive, as natural variations may be more fit for their changing environments

## Evolution of Multicellularity

- Occurred shortly after evolution of sexual reproduction
- Being multicellular was another HUGE advantage!
  - easier to _____, cells working together!
  - easier to _____, you’re bigger now!
- Led to rapid _____, greater diversity