

Introduction to Biology. Lecture 6

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Outline

- 1 Where we are?
- 2 Origin of life
 - Molecules of life
 - Primordial living structures
 - Alternatives and amendments to abiogenesis

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Evolution is the fact and research program

- Given the amount of evidence presented, evolution is a fact
- Evolution is also an extremely useful, working research program, both in biology and medicine

Origin of life

Molecules of life

Organic chemistry: chemistry of carbon

- Carbon skeleton
- And H, O, N, P, S

Four types of biomolecules

- Lipids: hydrophobic
- Carbohydrates (sugars): multiple –OH groups
- Amino acids: N + C + O and hydrogen
- Nucleotides: cycle with nitrogen (heterocycle), sugar and phosphoric acid



Organic polymers

- Polymeric carbohydrates: polysaccharides (like cellulose and starch)
- Polymeric amino acids: proteins
- Polymeric nucleotides: nucleic acids (DNA and RNA)

The very basic features of life

- Semi-permeable (proteins + lipids) membrane
- DNA → RNA → proteins sequence

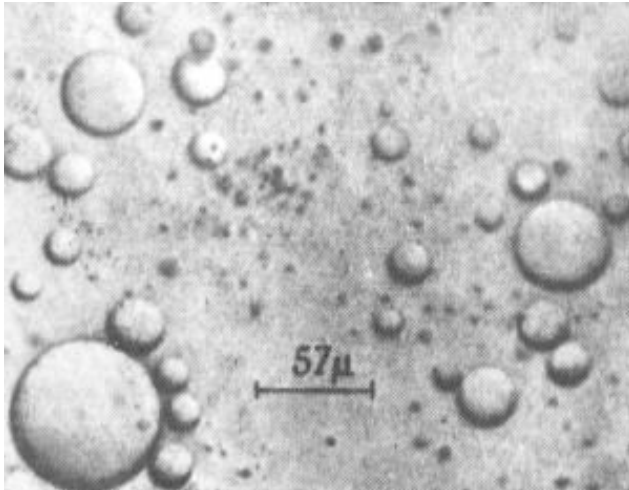
Origin of life

Primordial living structures

Coacervates

- Lipid globules capable to chemical exchange with environment
- Discovered by 1930s, used as an important proof of **abiogenesis** (Oparin's theory)

Coacervates

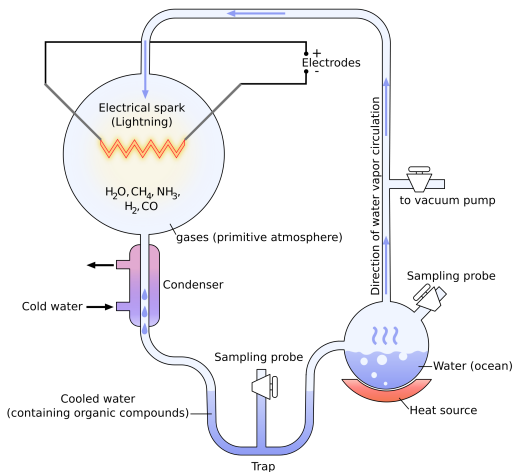


Abiogenesis of proteins

- In 1952, Miller-Urey experiment showed that formation of simple organic molecules is possible when Earth ancient atmosphere and temperature were imitated in lab
- In 1958, Fox and Harada found that “proteinoids” (short peptides) may be synthesized in similar conditions



Miller-Urey experiment



First steps, according to abiogenesis

- Primordial soup
- RNA world
- Proteins
- Cells: last universal common ancestor (LUCA)



Origin of life

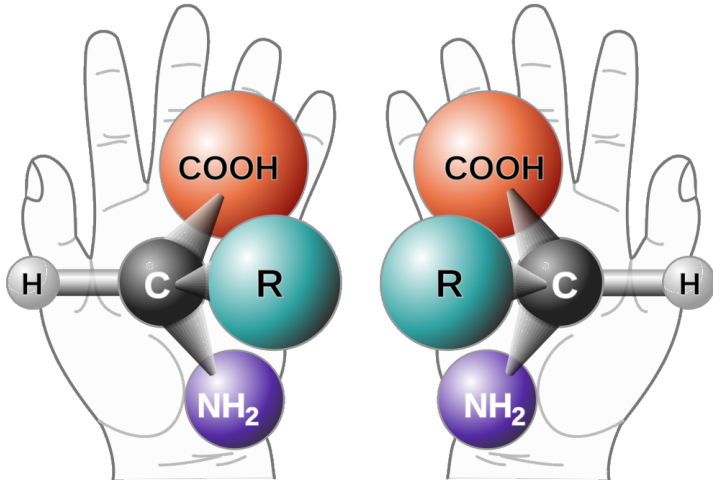
Alternatives and amendments to abiogenesis

Problems of abiogenesis: chiral purity of life

- Most of amino acids are chiral: they have “left” and “right” forms
- *All proteins from living organisms contain only “left” amino acids*
- Sugars (carbohydrates) could also be “left” and “right”
- *Nucleic acids contain only “right” sugars*



“Left” and “right” amino acids



Panspermia theory

- Life is a fundamental feature of Universe
- It always exist and constantly spreading

Self-organization

- Lovelock's (1982) Gaia hypothesis: Earth is a living being
- Life is a way of stabilizing geological cycles on Earth
- Self-organization was based on the principles of Prigogine's **non-equilibrium thermodynamics**
- Life first, organisms second



Summary

- Four types of biomolecules form biological polymers
- Abiogenesis is the most feasible theory of life origin

For Further Reading



Organic chemistry.

http:

[//en.wikipedia.org/wiki/Organic_chemistry](http://en.wikipedia.org/wiki/Organic_chemistry)



Origin of Life.

<http://en.wikipedia.org/wiki/Abiogenesis>