

Introduction to Biology. Lecture 8

Alexey Shipunov

Minot State University

February 1, 2017



Outline

- 1 Questions and answers
 - Exam 1
- 2 Where we are?
 - Molecules of life
- 3 Origin of life
 - Alternatives and amendments to abiogenesis
- 4 First life
 - Hadean and Archean eons



Outline

1 Questions and answers

- Exam 1

2 Where we are?

- Molecules of life

3 Origin of life

- Alternatives and amendments to abiogenesis

4 First life

- Hadean and Archean eons



Outline

- 1 Questions and answers
 - Exam 1
- 2 Where we are?
 - Molecules of life
- 3 Origin of life
 - Alternatives and amendments to abiogenesis
- 4 First life
 - Hadean and Archean eons



Outline

- 1 Questions and answers
 - Exam 1
- 2 Where we are?
 - Molecules of life
- 3 Origin of life
 - Alternatives and amendments to abiogenesis
- 4 First life
 - Hadean and Archean eons



Questions and answers

Exam 1



Results of Exam 1: statistic summary

Summary:

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.	NA's
29.00	63.00	72.00	71.41	81.00	100.00	7

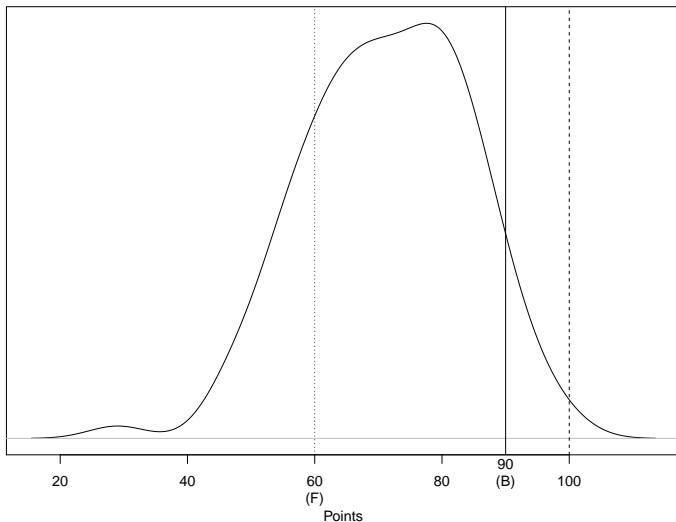
Grades:

F	D	C	B	max
< 60	< 70	< 80	< 90	100



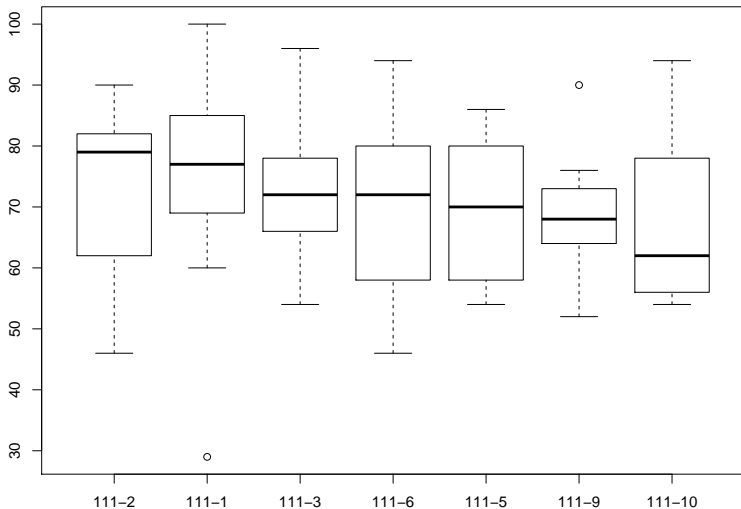
Results of Exam 1: the curve

Density estimation for Exam 1 (Biol 111)



Results of Exam 1: sections

Competition between Biol 111 sections (Exam 1)



Results of Exam 1: some questions

6. Who told that “*Nothing in Biology Makes Sense Except in the Light of Evolution*”?
- A Bertrand Russel
 - B Charles Darwin
 - C **Theodosius Dobzhansky**
29. How many grams of phosphoric acid we should dilute in 1 liter of water to obtain 1 M concentration?
- A 7 g
 - B 48 g
 - C **98 g**
47. What is a most striking difference between carbohydrates and amino acids?
- A Carbohydrates are sweet, amino acids are not
 - B **Amino acids contain nitrogen, carbohydrates do not**
 - C Carbohydrates are hydrophobic, amino acids are not
49. Which basic feature of life is modeled in coacervates?
- A DNA → RNA → proteins
 - B **Semi-permeable membrane**



Where we are?

Molecules of life



Four types of biomolecules form biological polymers

- Lipids
- Sugars make polysaccharides
- Amino acids make proteins
- Nucleotides make nucleic acids



Abiogenesis is the most feasible theory of life origin

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



Origin of life

Alternatives and amendments to abiogenesis

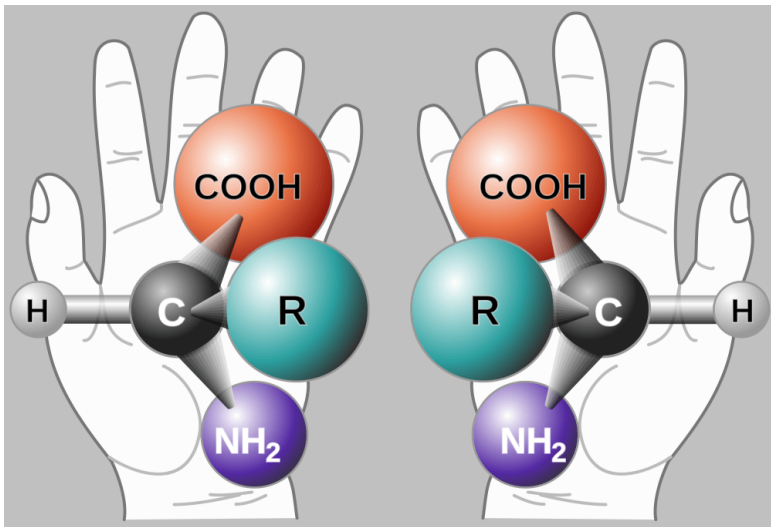


Problems of abiogenesis: chiral purity of life

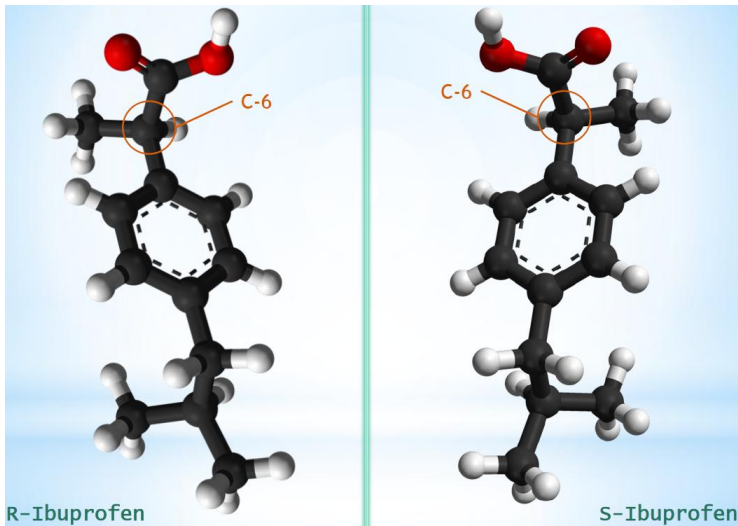
- Most of amino acids and other biological molecules are **chiral**: they have “left” and “right” forms
- *All proteins from living organisms contain only “left” amino acids*
- Sugars (carbohydrates) could also be “left” and “right”
- *Nucleic acids contain only “right” sugars*



“Left” and “right” amino acids



“Left” and “right” ibuprofen



First is a drug, second is almost useless!



Panspermia theory

- Life is a fundamental feature of Universe
- It always exists 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



First life

Hadean and Archean eons



First evidences of life

- Earth age is usually estimated as 4600 Mya (million years ago), Hadean eon was the first epoch
- First minerals are ≈ 4000 Mya, they mark Archean eon



Oldest evidences of life and photosynthesis

- The oldest organic carbon is ≈ 3800 Mya (Greenland, Mesoarchean)
- Organic carbon: carbon with $^{13}\text{C}/^{14}\text{C}$ ratio like in living plants
- Oldest remnants of chlorophyll: 3100 Mya (Mesoarchean)



Photosynthesis

- $\text{CO}_2 + \text{H}_2\text{O} \xrightarrow{\text{light, chlorophyll}} \text{carbohydrates} + \text{O}_2$
- Two stages:
 - A Light-dependent: production of energy (ATP) and photolysis of water
 - B Light-independent: assimilation of CO_2 into carbohydrates
- Then carbohydrates are partly converting into lipids; with addition of N—into amino acids; with addition of N and P—into nucleotides



Summary

- Photosynthesis changed the atmosphere of Earth



For Further Reading



Photosynthesis.

<http://en.wikipedia.org/wiki/Photosynthesis>
(introduction)

