

# Introduction to Biology. Lecture 3

Alexey Shipunov

Minot State University

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- 1 Where we are?
- 2 Age and time
  - Some basic principles of science
- 3 Origin of Earth. Basic Chemistry
  - Origin of Earth
  - Very basics of chemistry



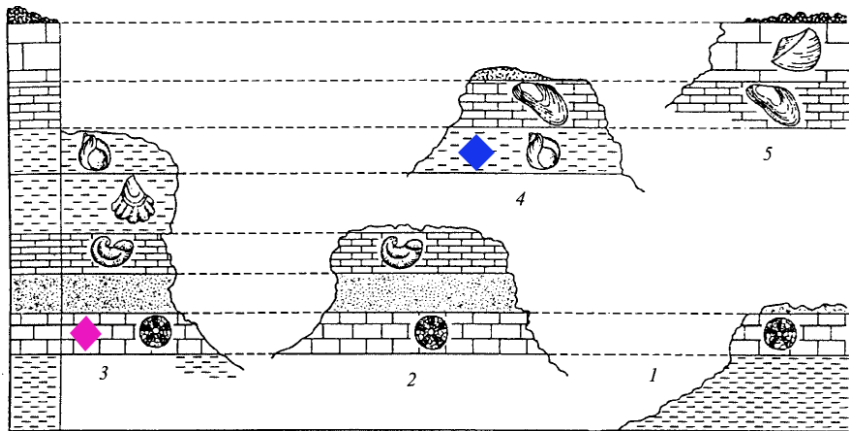
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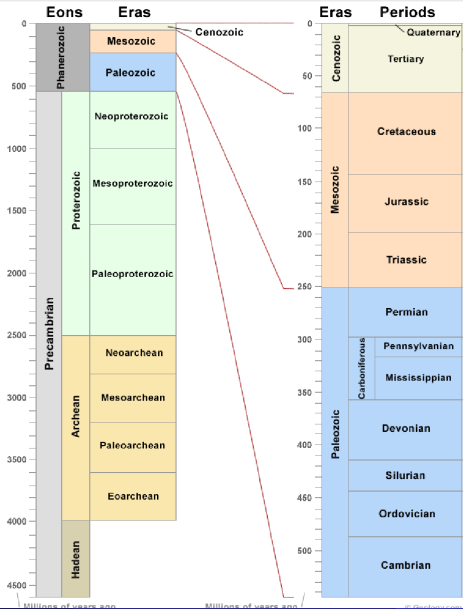
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# Stratigraphy and radioactivity works together



# Geological scale (variant 2)



# Age and time

## Some basic principles of science



# Principle of actuality

- Charles Lyell (1830)
- “The present is the key to the past”





# Occam's razor

- Father William of Ockham (ca. 1300)
- “Plurality must never be posited without necessity”



# Science as falsification

- Karl Popper (1963)
- “If something cannot be proved wrong, then it is meaningless”



# Example of non-falsifiable hypothesis: Russel's teapot

... If I were to suggest that between the Earth and Mars there is a china teapot revolving about the sun in an elliptical orbit, nobody would be able to disprove my assertion provided I were careful to add that the teapot is too small to be revealed even by our most powerful telescopes.

(Bertrand Russel, 1952)



# Null and alternative hypotheses

- Ronald Fisher (1935)
- **Null**: nothing happened; **alternative**: something happened
- Normally, we are able only to reject one of them and therefore **fail-to-reject** (not “support”!) the other



# Basic science principles

- Actuality
- Occam's razor
- Falsification
- Hypothesis testing



# Origin of Earth. Basic Chemistry

## Origin of Earth

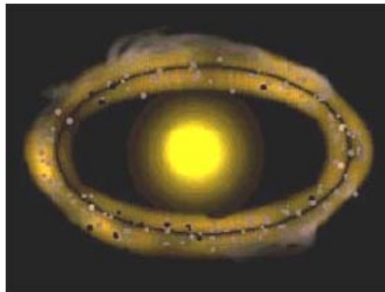
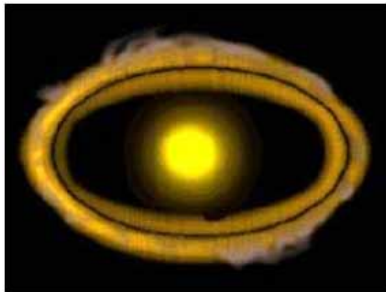


# Nebula theory: cold Earth

- Pierre-Simon Laplace (1796): Earth originated from a “dust cloud”
- When cloud started to rotate around the Sun, the differentiation into planets started



# Nebula: first and second steps





# Heating: differentiation of depths

- “Heavy” elements went to the Earth center, light elements—to the surface
- The energy of this movings came out as warmth, and Earth melted (partly)

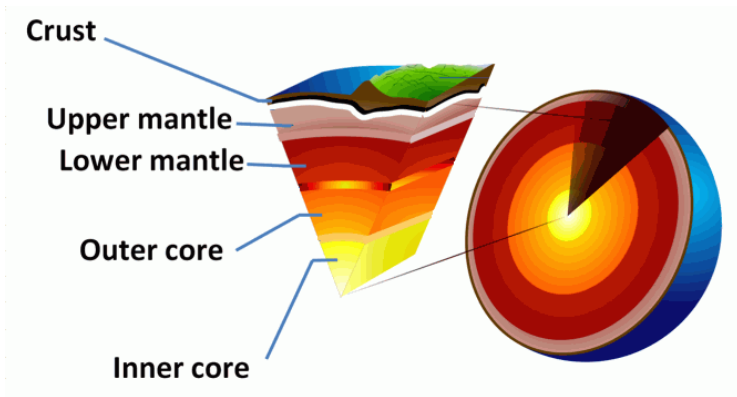


# Structure of Earth

- Now, Earth is spheric drop of extremely viscous and heavy “liquid”
- This drop is structured into several layers. Most important are: crust, mantle and core.



# The section of Earth



# Atmosphere and hydrosphere

- The differentiation of Earth body finally resulted in developing of lighter gas layer on the surface (primary atmosphere), initially very thin and relatively cold ( $\approx 15^{\circ}\text{C}$ )
- Therefore, water vapor were condensed into primary ocean (primary hydrosphere)



# Chemistry of atmosphere and hydrosphere

- According to the principle of actuality, it should be close to today's volcanic gases
- 15% of  $\text{CO}_2$ , plus  $\text{CH}_4$  (methane),  $\text{NH}_3$  (ammonia),  $\text{H}_2\text{S}$ ,  $\text{SO}_2$  and different “acidic smokes” like  $\text{HCl}$



# Origin of Earth. Basic Chemistry

Very basics of chemistry



# Very basics of chemistry

- **Atoms**
  - **Protons**
  - **Neutrons**
  - **Electrons**
- Atomic weight
- Isotopes
- Elements and periodic table
- Chemical bonds
- Valence
- Molecules
- Molecular weight



# Summary

- Geological time is calculated on the basis of both relative (stratigraphy) and absolute (radioactivity) methods
- Science is based on the principles of actuality, falsification, Occam's razor, and hypothesis testing





# For Further Reading



[Structure of the Earth. Wikipedia.](#)

`http:`

`//en.wikipedia.org/wiki/Structure_of_the_Earth`



[Atom. Wikipedia.](#)

`http://en.wikipedia.org/wiki/Atom (until "Identification").`

