

# Introduction to Biology. Lecture 3

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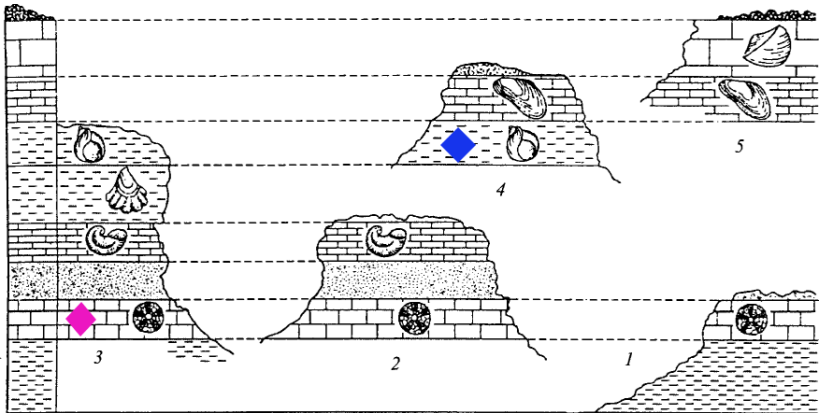
# Outline

- 1 Where we are?
- 2 Origin of Earth. Basic Chemistry
  - Origin of Earth
  - Very basics of chemistry

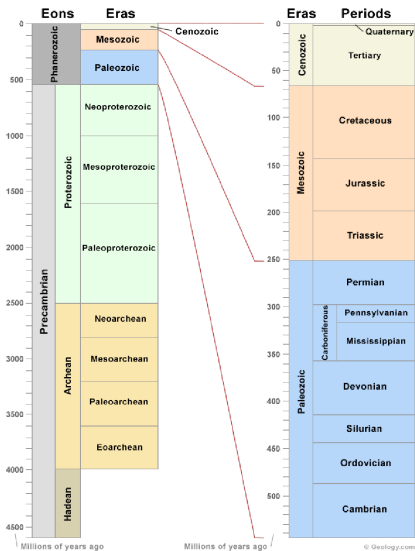
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# Stratigraphy and radioactivity works together



# Geological scale (variant 2)



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# Basic science principles

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

# 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



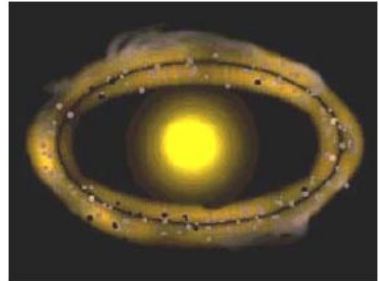
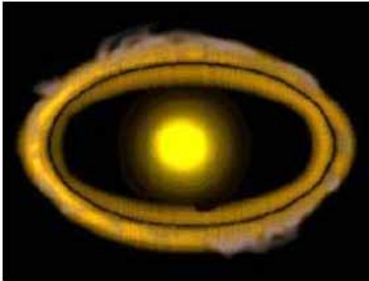
# Origin of Earth. Basic Chemistry

## 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



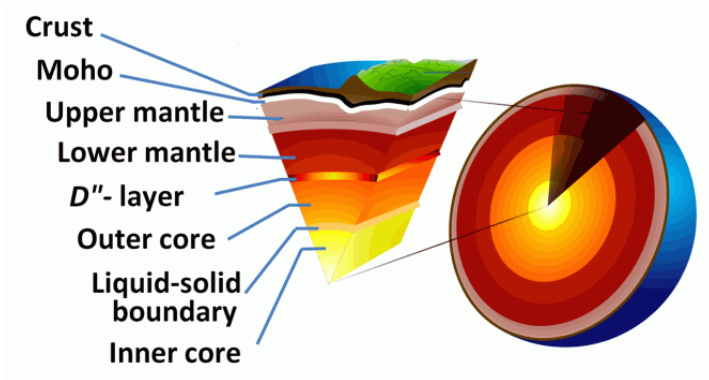
# Heating: differentiation of depths

- “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

# Acids and bases

- Acids: take out  $\text{H}^+$  (proton)
- Bases: take out  $\text{OH}^-$  (hydroxyl)

# Concentration

- Amount of dissolved substance
- If concentration of protons is 1 unit ( $1 \times 10^1$ ), this is an extremely acidic solution
- In distilled water, concentration of protons equal to  $1 \times 10^{-7}$  (0.0000001) units
- pH of distilled water is equal to  $-\log(10^{-7}) = -(-7) = 7$
- pH of the extremely acidic solution (first example) is 1



# 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](http://en.wikipedia.org/wiki/Structure_of_the_Earth)



## Atom. Wikipedia.

<http://en.wikipedia.org/wiki/Atom> (until “Identification”).