Introduction to Biology. Lecture 12

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September 29, 2014

Outline

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1. Where we are?
   - Proterozoic challenge
2. Eukaryotic cell
   - Organelles and their functions
   - Evolutionary steps towards the eukaryote
   - Cell division

Where we are?
Proterozoic challenge

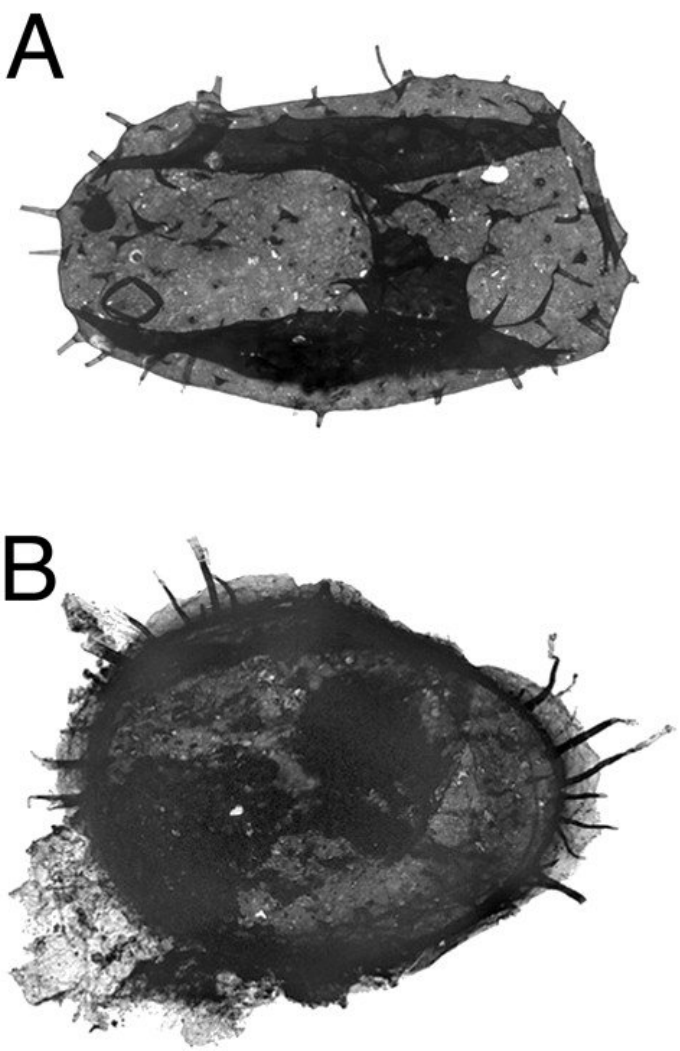
ATP, carbohydrates, photosynthesis and respiration

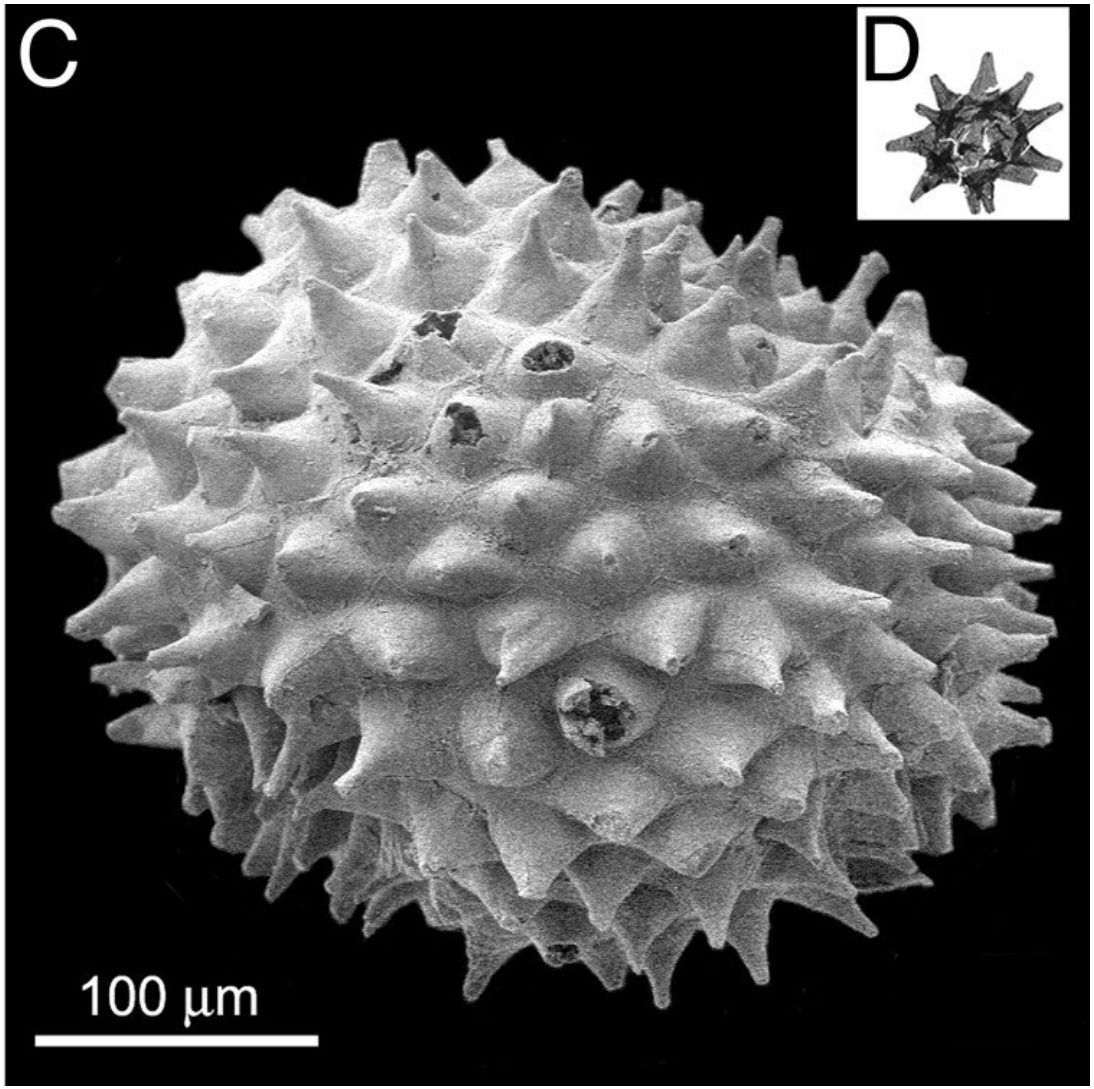
- If organism is capable to convert sun energy into ATP, it is a phototroph
- If organism is using carbon dioxide to build its own organic (ATP is required here!), it is an autotroph
- Most of plants are photoauthotrophs, because photosynthesis (combination of the above two processes) is prevalent in their life
- Animals are heterotrophs, they do respiration which is opposite to autotrophy: it breaks organic into inorganic and create ATP

Eukaryotic cell as a response to Proterozoic challenge

- Predators
- New pathways of protein synthesis
- Cytoskeleton allows for cytoplasm motility
- Nucleus for DNA security and distribution
- Mitochondria make ATP

Acritarchs in Proterozoic (1,900 Mya)





Eukaryotic cell

Organelles and their functions

Eukaryotic cell

Membrane and cytoplasm

- Cytoplasm is constantly flowing
- Membranes are using for construction of multiple internal organelles

Cytoskeleton

- Microtubules and microfilaments
- Flagella
- Phagocytosis
- Motility
- No cell wall (but note that plants and fungi developed cell wall again)

Nucleus

- Regulatory DNA
- Cell division
- Pores

Mitochondria

- Respiration machines
- Mitochondrial DNA

Internal membrane system

- ER
- AG
- Vesicles: vacuoles, lysosomes, peroxisomes etc.

Ribosomes

- Bigger
- Associated with ER

Eukaryotic cell: pluses and minuses

- Flexible, but bigger and no cell wall
- Nucleus, but so many DNA poses a problem
- Mitochondria are very effective, but less controlled

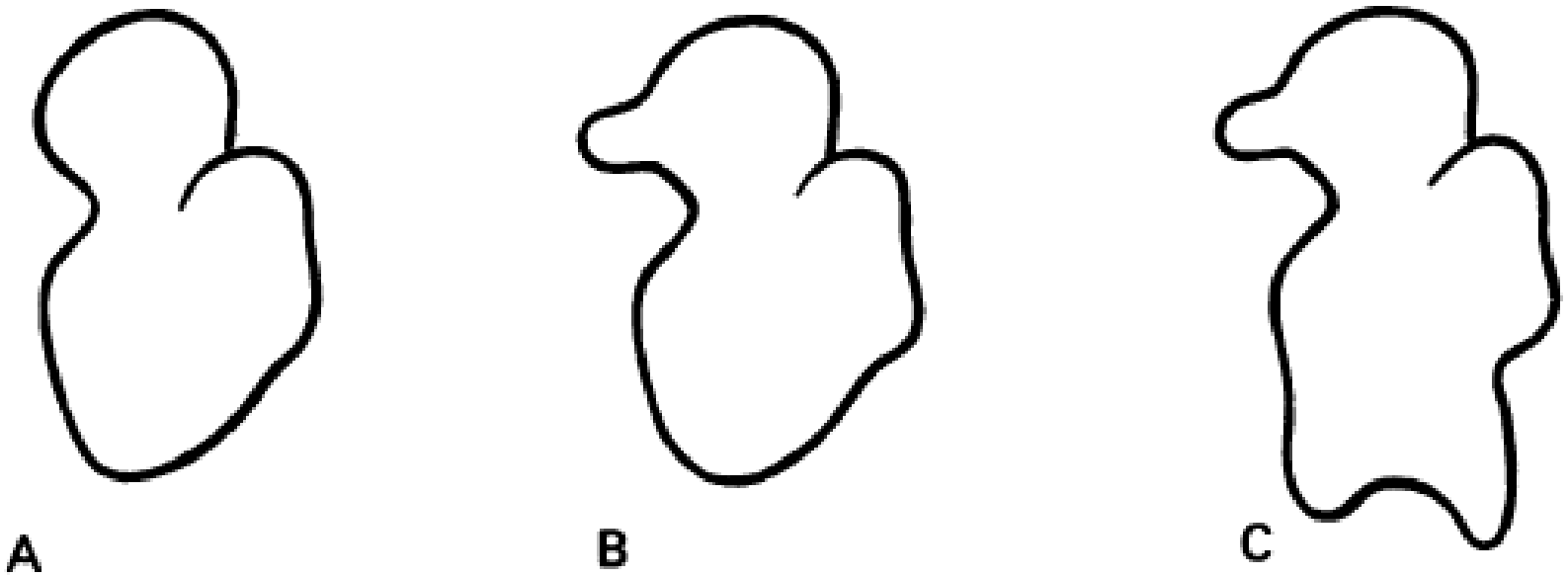
Eukaryotic cell

Evolutionary steps towards the eukaryote

Antibiotic resistance and actin

- Archebacteria were probably first prokaryotes who changed their biosynthetic pathways in order to become resistant to majority of antibiotics
- They also invented actin, the main protein of cytoskeleton

Ribosomes of core bacteria (A), archebacteria (B) and eukaryotes (C)



Taking mitochondria: symbiogenesis

- Mitochondria were separate organisms
- Eukaryotic cell is a “second-level” cell, cell from cells

Eukaryotic cell

Cell division

Cell cycle

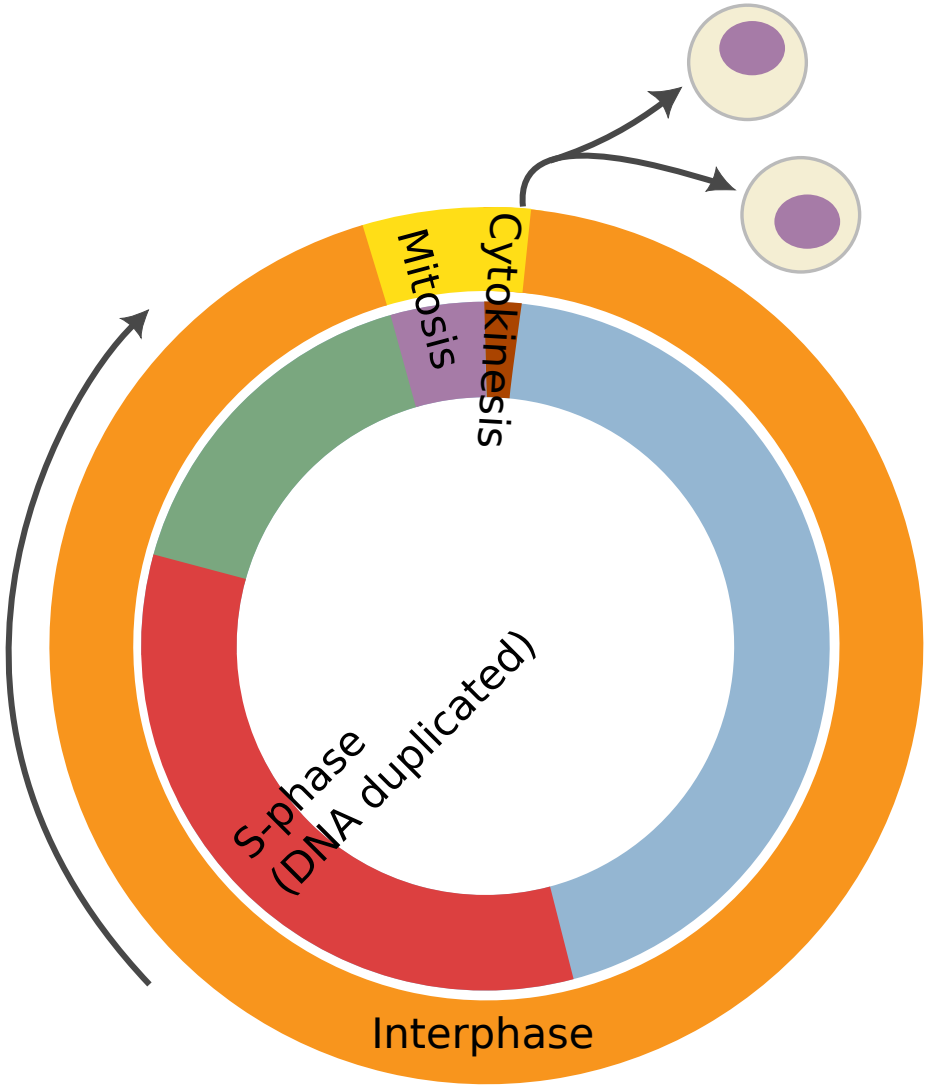
- To multiple, cell should first store energy for DNA duplication
- Then—duplicate its DNA (S-period)
- And only then to divide DNA (mitosis) and the rest of cell (cytokinesis)

This is the **cell cycle**

Mitosis

- Mitosis is an equal division of nucleus where daughter cells will receive the same DNA information as mother cell
- **The goal of mitosis** is the equal distribution of pre-duplicated DNA
- Time between two cell divisions is called **interphase** so cell cycle = interphase + mitosis + cytokinesis

Cell cycle



Summary

- Eukaryotic cell is a “second-level”, enhanced cell
- Symbiogenesis is one of evolutionary steps towards eukaryote
- Mitosis is an equal division of nucleus

For Further Reading

Symbiogenesis.
http://en.wikipedia.org/wiki/Endosymbiotic_theory

Eukaryote.
http://en.wikipedia.org/wiki/Eukaryote