Introduction to Biology. Lecture 11

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September 26, 2014

Outline

Where we are?
Basics of ecology

Ways of life

- How to obtain energy?
  - A From sun light: **phototrophy**
  - B From chemical reactions with inorganic matter (“rocks”): **lithotrophy**
  - C From breaking organic molecules into inorganic (typically, carbon dioxide and water): **organotrophy**
- How to obtain building blocks?
  - A From assimilation of carbon dioxide: **autotrophy**
  - B From other living beings: **heterotrophy**

Six life styles

	Phototrophs	Lithotrophs	Organotrophs
Autotrophs	...	...	...
Heterotrophs	...	...	...

Where we are?
Ecological interactions

Two-species model

- Species I and species II may influence each other differently
- For example, species I may facilitate the increase the number of species II individuals ($+$ interaction)
- At the same time, species II could be neutral to species I (0 interaction)

Six basic ecological interactions

	+	0	−
+	mutualism	commensalism[1]	exploitation[2]
0	...	neutralism	amensalism
−	...	...	interference[3]

[1] Includes phoresy (transportation), inquilinism (housing) and “sponging”
[2] Includes predation, parasitism and phytophagy
[3] Includes competition, allelopathy and aggression

Where we are?
Proterozoic challenge

Proterozoic challenge

- Archean ecosystems were based on “clone wars” using antibiotics, horizontal transfer of genes and splitting jobs. However, they were incomplete: no predators.
- To predate, one need to *make large cell and invent the phagocytosis* (cellular “swallowing”)
- To escape from antibiotics, one need a different chemical machines for protein biosynthesis

However,

- Large and complicated cell needs more DNA—but how to divide it equally?
- Horizontal transfer will hinder evolution towards something unusual—but how to stop it?
- Large and complicated cells need much more ATP—how to make it?

Two problems

- How to escape from antibiotics?
- How to predate?

Eukaryotic cell as a response to Proterozoic challenge

- New pathways of protein synthesis
- Cytoplasm motility (flagella, phagocytosis) based on cytoskeleton $\rightarrow$ no cell wall
- Nucleus for interphase and chromosomes for mitosis (too many DNA)
- Mitochondria for ATP (cell needs much more ATP)

Summary

- All life styles were exist before eukaryotic origin
- The only interaction absent in prokaryotic communities was predation
- Eukaryotic cell is a “second-level”, enhanced cell

For Further Reading

Ecological interactions.

`http://en.wikipedia.org/wiki/Biological_interaction`

Symbiogenesis.

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

Eukaryote.

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