

Lecture Number 2: Structure and Function of Prokaryotic Cells

Topics:

- Eukaryotic vs prokaryotic cells (**3: 68-69**).
- Origin of Eukaryotic cells from Prokaryotic Cells?
- Structure of the prokaryotes, the super Kingdoms Archaea and Bacteria(**33: 782-787**).
- Why study Bacteria? Cause of many diseases. Decomposers and recyclers. Agents in industrial and agricultural processes. Agents for nitrogen fixation. Major primary producers – the Cyanobacteria (**Chapter 33, sections relevant to the lecture**).
- Cyanobacteria (**33: 788-789**).

Lecturer:

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Recommended Reading:

All citations are from: Knox, Ladiges, Evans & Saint "*Biology*" 3rd Edition (McGraw-Hill, 2005); citations are for Chap:page number, thus: **33:788**.

Theme/Objective:

To understand the difference between eukaryotic and prokaryotic cells. To understand the structure, diversity and function of archaea and bacteria, and how they differ. The importance of cyanobacteria.

Keywords/concepts:

Prokaryotes, eukaryotes, cell, cell membrane, archaea, bacteria and cyanobacteria, ribosome, protein, DNA, cell wall.

Summary of Lecture:

1. Prokaryotic vs Eukaryotic cells: As stated in the notes from lecture #1, the greatest division amongst organisms is between those cells that have nuclei (said to be eukaryotic) and those that lack nuclei (or prokaryotic). Of all cells, ONLY bacteria and Archaea have prokaryotic structure, and these two super Kingdoms are very different from one another .

2. Origin of Eukaryotic cells from Prokaryotic Cells? We have an idea of when eukaryotic cells first arose from the fossil record, but the origin of eukaryotic cells is not known. Evolution theory states that eukaryotic cells evolved from prokaryotic cells.

3. Prokaryotic Cells: There are two super Kingdoms of prokaryotes, the bacteria (including the cyanobacteria) and Archaea, or simplest of cells. We have only just begun to understand the Archaea. Prokaryotic cell structure is very simple, and is

illustrated in the lecture and in your book. Their mechanism of cell division is also simple when compared to eukaryotic cells.

There are about 2000 species, ubiquitous micro organisms (1-10 μ m), very important in environment for decomposition of organic matter to recycle nutrients, major cause of disease (eg, typhoid, cholera, dysentery, TB, plague, gangrene, VD, tetanus, pneumonia, Legionnaire's) and vital in food production (eg, cheese, yogurt, sour cream, sauerkraut, vinegar, citric acid). Most bacteria are heterotrophic, some are able to photosynthesize (photoautotrophs), some are able to oxidize inorganic compounds and harvest energy (chemoautotrophs) and some are able to fix nitrogen from air (important source of green "fertilizer").

How do Archaea differ from Bacteria

- Morphologically they don't.
- Over half of archaean genes were new to science.
- Biochemically, Archaea are nearly as different from Bacteria as they are from Eukaryotes (making them a super kingdom).
- The two central processes in molecular biology, genetic transcription and translation are more similar to those of eukaryotes than bacteria.
- Features of the archaean lipids and their membranes are unusual and Archaea lack a peptidoglycan wall (except for a few organisms, and in those circumstances, the peptidoglycan is biochemically distinctive from the bacterial peptidoglycan).
- Most archaeans are extremophiles - hot, cold, acidic, alkaline, highly saline, extreme pressure etc.)
- As of 2008, no clear examples of archaean pathogens are known.
- Eukaryotes have almost equal numbers of genes from both Archaea and Bacteria. The Eukaryotes appear to have arisen from both, but how?

Prokaryotes are normally unicellular or filamentous. They are ubiquitous with a wall of **murein peptidoglycan** (penicillin blocks synthesis). The cell structure is very simple, with a cell membrane, mesosome, circular chromosome + plasmids and small ribosomes. When present, flagella are simple in structure when compared to eukaryotes. Bacterial flagella are extracellular and composed of flagellin. Reproduction is by simple binary fission.
