

Introduction to Archaea and Bacteria

1. Define:

Archaea – Organisms categorized within the domain Archaea have prokaryotic cells, but are unlike bacteria in that they never have peptidoglycan in their cell walls, their cell membranes contain lipids of unique composition (glycerol molecules are mirror images of those found in other cells, and form ether linkages to isoprenoid side chains), and the 16S ribosomal-RNA nucleotide sequences are unlike those of bacteria. Many Archaea inhabit unusual environments and some have histone proteins that are usually lacking in bacteria. Examples include methanogens, extreme halophiles and thermoacidophiles.

Bacteriorhodopsin – Bacteriorhodopsin is an integral membrane protein produced by Archaea in the genus *Halobacterium*. This pink-purple colored protein changes configuration when exposed to light, and transports hydrogen protons across cell membranes (out of the cell). Phototrophic Archaea use it to generate the proton motive force necessary for ATP production through photophosphorylation. This protein is related to the rhodopsin found within the human retina.

Luciferase – Luciferase enzymes are produced by bioluminescent organisms (e.g., *Photobacterium*), and are encoded by regions of DNA called Lux genes. These enzymes are used to convert chemical energy into light energy, thus allowing organisms to glow in the dark.

Leghemoglobin – Leghemoglobin is a red-colored, oxygen-absorbing protein similar to the hemoglobin found within RBCs, but formed within the root nodules of leguminous plants that have been colonized by nitrogen-fixing bacteria in the genus *Rhizobium*. By reducing free oxygen levels within root nodules, leghemoglobin creates an environment that promotes the nitrogen-fixing activity of *Rhizobium*, and it also provides oxygen to the aerobic bacteria.

Anoxygenic – Anoxygenic means without oxygen production (an = without, oxygenic = oxygen generation). The term typically applies to organisms that do not produce oxygen in association with their photophosphorylation activities. *Rhodospirillum* is one example of an anoxygenic phototroph.

2. Archaea/ peptidoglycan
3. Archaea are unlike bacteria in that they never have peptidoglycan in their cell walls, their cell membranes contain lipids of unique composition (glycerol molecules are mirror images of those found in other cells, and form ether linkages to isoprenoid side chains), and their 16S ribosomal-RNA nucleotide sequences are unlike those of bacteria.
4. Methanogenic/ bacteriorhodopsin
5. Deinococcus-Thermus
6. Cyanobacteria/ microcystins
7. *Wolbachia*
8. *Rhizobium/ Photobacterium/ luciferase*
9. *Sphaerotilus/ Thiobacillus*

10. Pseudomonads are used extensively in bioremediation (removing toxic waste materials from soil and/or water). They may be used to help clean up ocean beaches or other water environments that have been polluted due to oil spills, and they can be used to remove toxic chemicals from soil.
11. Bioluminescent/ lux gene
12. *Escherichia coli* (*E. coli*)
13. *Bdellovibrio*
14. *Mycoplasma*
15. *Bacillus*
16. *Lactobacillus/ Streptococcus* (Bacteria in the genus *Lactococcus* are also used.)
17. *Micrococcus*
18. *Mycobacterium*
19. Antibiotics/ geosmins
20. *Chlamydia*
21. Spirochetes
22. Matching letter sequence is - G, C, I, H, J, B, A, E, D, and F