

Lecture 22: The Archaea (Bergey's Manual: Volume 1)

I. General Characteristics

Cell size	
Shape	, rod, lobed, plate-shaped, irregular or
Arrangement	single cells, or aggregates
Reproduction	, budding, fragmentation or other mechanisms
Metabolism	very range from chemolithoautotrophs to organotrophs aerobic, facultatively anaerobic, anaerobic
Environment	
Cell wall structure	but may contain other structural polysaccharides (e.g. pseudomurein), have only , may have a layer of protein or glycoprotein outside the membrane, stain either
Lipids	Hydrocarbon side chains of lipids are branched and attach to the glycerol backbone via a
Genetics and molecular biology	Share gene sequences with both bacteria and tRNAs have different nucleotide composition, ribosomes are variable in shape, are sometimes present and enzymes and promoter sequences are more like those of eukaryotes

II. Phylum *Crenarchaeota*

A. Most are *thermophiles* (e.g. *Pyrodictium* grows optimally at 105°C)

B. Many are *halophiles* and are sulfur dependent

C. Contains both *thermophiles* and *halophiles* members (hydrogen gas and sulfur are the most common sources of electrons)

D.

1. Aerobic, irregular lobed spherical archaeons

2. *Halobacterium salinarum* (temperature range: 70-80°C, pH range: 2-3)

3. Grow lithotrophically by oxidizing sulfur to

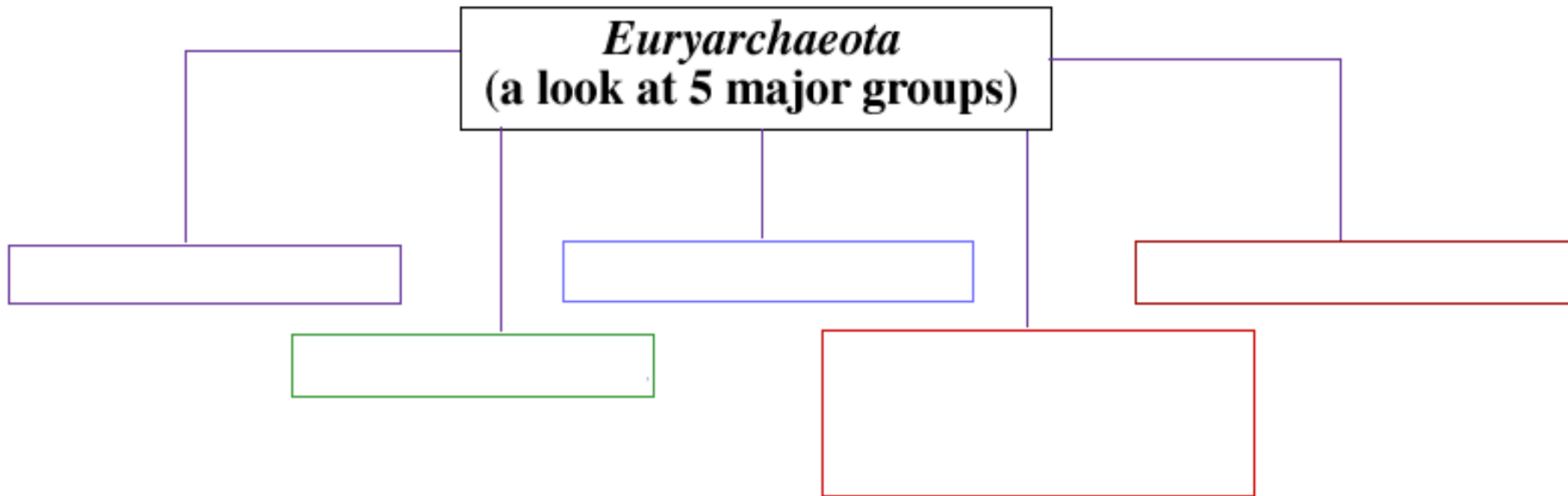
E.

1. Long, thin that may be bent or branched
2. Strictly (temperature range: 70-97°C, pH range of 2.5-6.5)
3. Found in rich in sulfur
4. Can grow using glucose, amino acids, alcohols and organic acids. Sulfur serves as the terminal electron acceptor in
5. Can also grow chemolithoautotrophically using hydrogen gas or sulfur as an energy source.

http://serc.carleton.edu/microbelife/yellowstone/virus_hosts.html

Wolfram Zillig in 2002

II. Phylum *Euryarchaeota*



A.

1. Strict

2. group of archaea with 5 orders and 27 genera.

3. Generate ATP by , CO₂, formate, methanol or acetate:



2. Cell shapes include . Representative genera
include *Methanospirillum* and *Methanosarcina*.
Fig. 18.13 (8th ed.) or 20.13 (9th ed.)

3. Found in anaerobic environments where H_2 and CO_2 are found such as
marine sediments, rice paddies and of humans and animals.



Picture taken by Rachel in England 2006

B. The Halobacteria (15 genera in 1 family)

1. with respiratory metabolism, require complex nutrients such as proteins and amino acids
 2. Nonmotile or motile via flagella
 3. Require at least , at $[\text{NaCl}] < 1.5 \text{ M}$, the cell wall
 4. Often have red to yellow (photosynthetic)
- Fig. 18.16 (8th ed.) or 20.17 (9th ed.)

<http://www.desertusa.com/mag98/april/owens/owenslake.html>

C. The Thermoplasms

1. and facultatively anaerobic

One class: *Thermoplasmata* - thermoacidophiles that

2.

a. Grows in refuse piles of that contain FeS (pyrite). The FeS gets oxidized to form sulfuric acid which creates hot, acidic conditions perfect for *Thermoplasma*.

b. (temperature range: 55-59°C, pH range: 1-2)

c. cell shape

http://www.ebi.ac.uk/2can/bioinformatics/images/genomes_archaea.gif

3.

a. Thermoacidophile (temperature range: 47-65°C, pH range:)

b. Has an

c. Small, irregularly-shaped

http://www.g2l.bio.uni-goettingen.de/images/bakt_pt.gif

C. Extremely thermophilic sulfur-metabolizers

1. Obligately (hyper) thermophilic (optimum between:)
- 2.

<http://www.biologie.uni-regensburg.de/Mikrobio/Thomm/Buttons/bilder/thermococcus-ch-Pt.jpg>

3. Most reduce sulfur to anaerobically

4. Genera include: *Thermococcus*, *Paleococcus* and *Pyrococcus*

D. Sulfate-reducing archaea

1. Irregular cocci
2. Form from thiosulfate and sulfate
3. Extremely thermophilic and strictly anaerobic
4. (optimum temperature = 83°C)
-often sours oil wells

http://www.nature.com/genomics/images/archaeoglobus_200.jpg