“Archaebacteria”

Archae - Bacteria

Archae means *Ancient*

The word ***Archae*** came from the Greek word ***Arkhaion***, which means ***Ancient***.

Archae is also the *Latin name* for *Prokaryotic Cells*.

Archaea that growing the hot water of the *Hot Spring* in *Yellowstone National Park* produce a bright yellow colour.

Reference - http://fineartamerica.com/featured/emerald-pool-hot-springs--yellowstone-national-park-gary-whitton.html

Characteristics of Archaebacteria

Type of Organism:
Unicellular

Cellular Structure:
Prokaryotic

Habitat: *Extreme Environment*

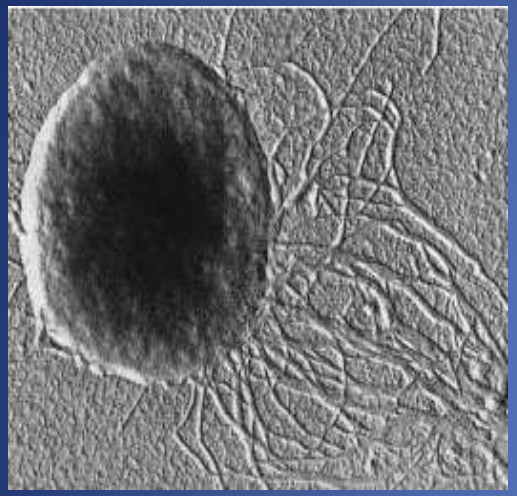
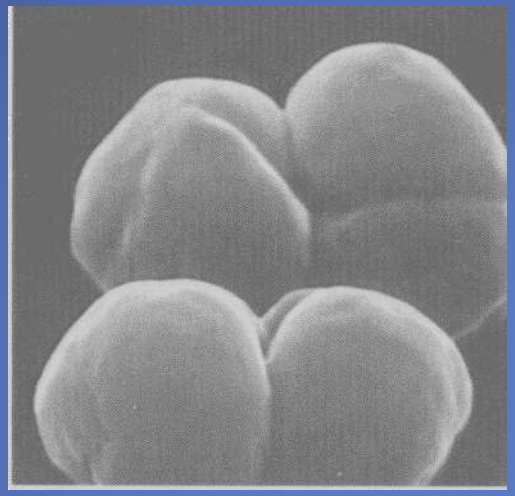
Peptidoglycan in Cell Wall:
Absent

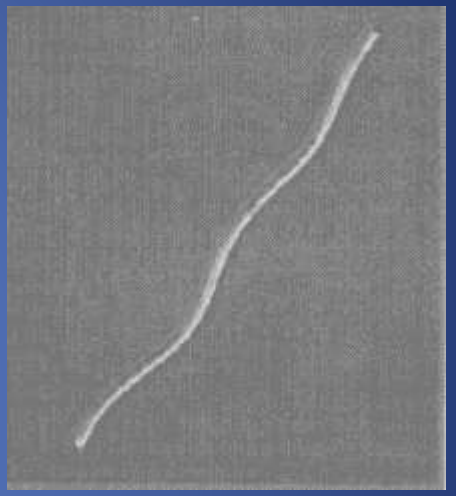
Reproduction Method:
Asexual **(Binary fission)**

Nutrition Mode:
Heterotrophs/Autotrophs

Reference - http://classes.midlandstech.edu/carterp/courses/bio225/chap04/lecture1.htm

Basic Archaeal Shapes

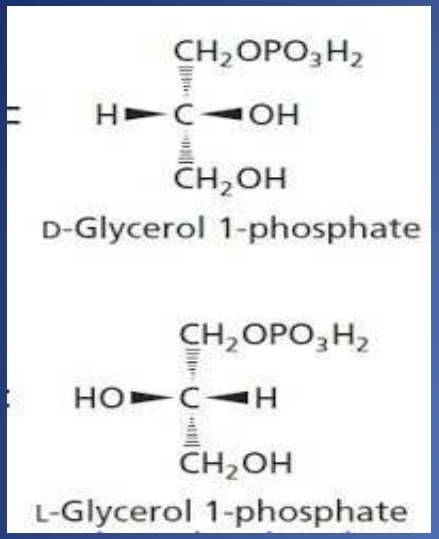



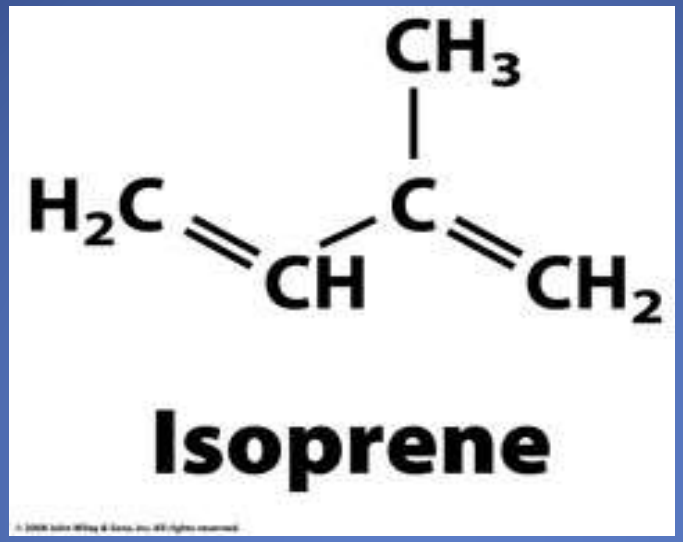


At far left, Methanococcus janaschii, a coccus form with numerous flagella attached to one side. At left center, Methanosarcina barkeri, a lobed coccus form lacking flagella. At right center, Methanothermus fervidus, a short bacillus form without flagella. At far right, Methanobacterium thermoautotrophicum, an elongate bacillus form.

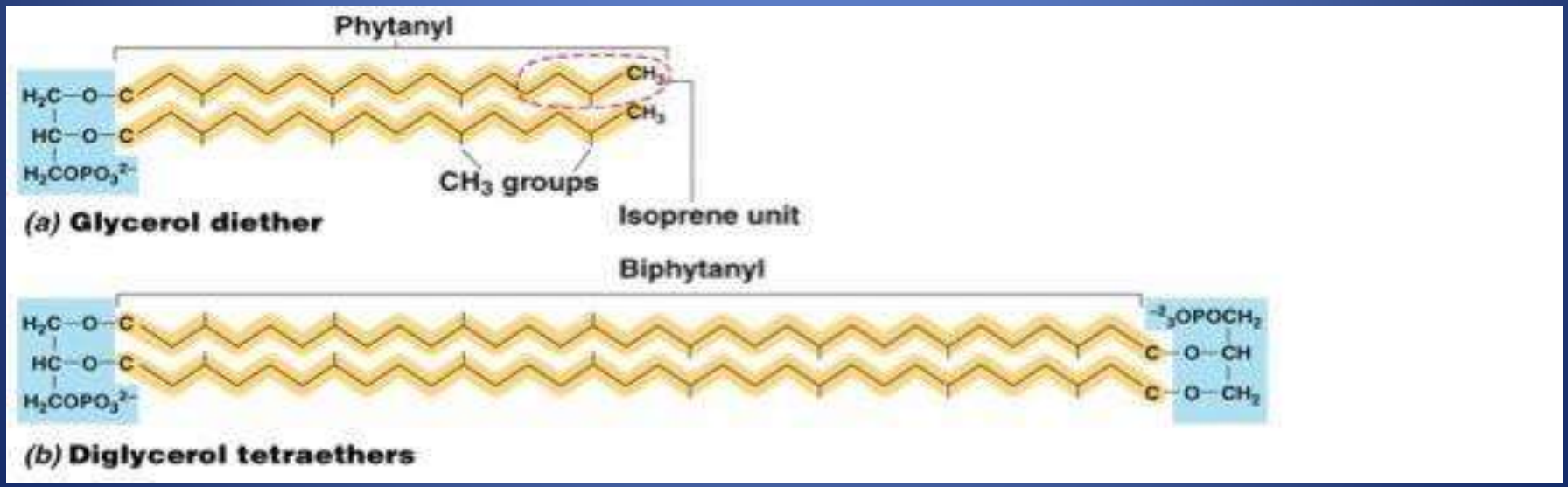
Reference - http://www.ucmp.berkeley.edu/archaea/archaeamm.html#isoprene

Archaeal Cell Wall

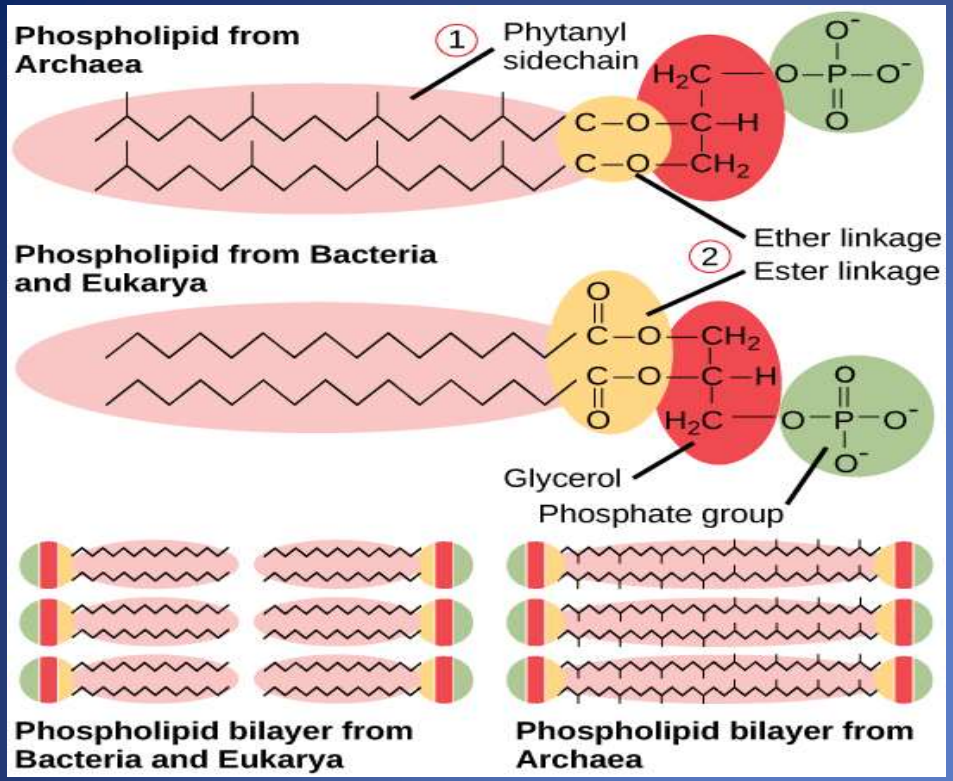


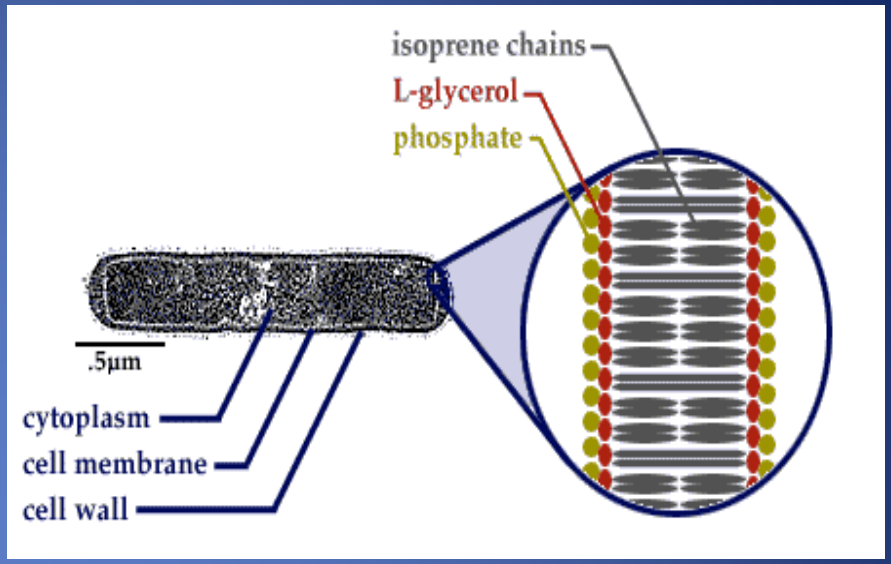


$CH_2=C(CH_3)CH=CH_2$

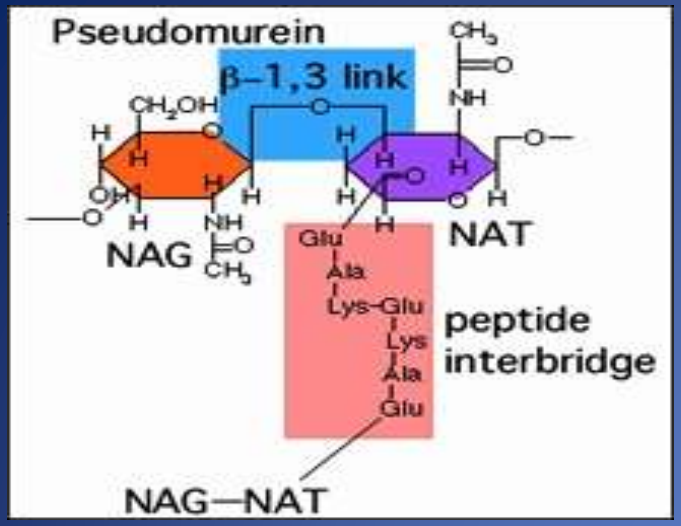


Reference - http://202.204.115.67/jpkch/jpkch/2008/wswx/chapter%203.htm

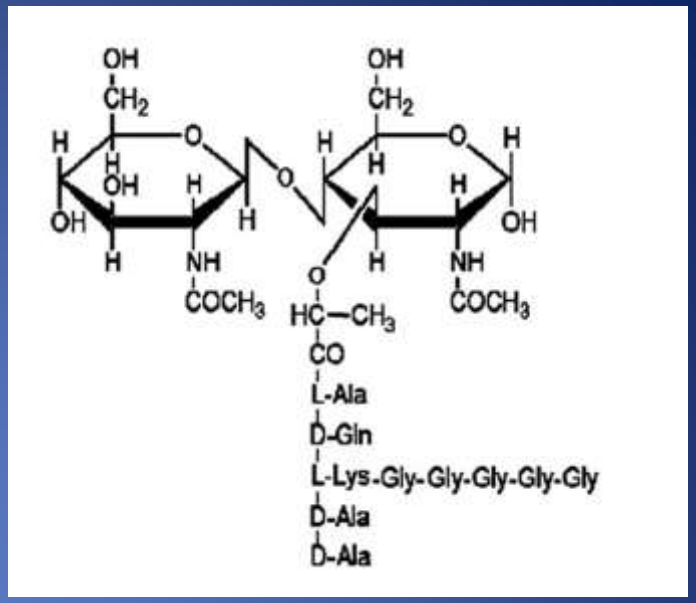




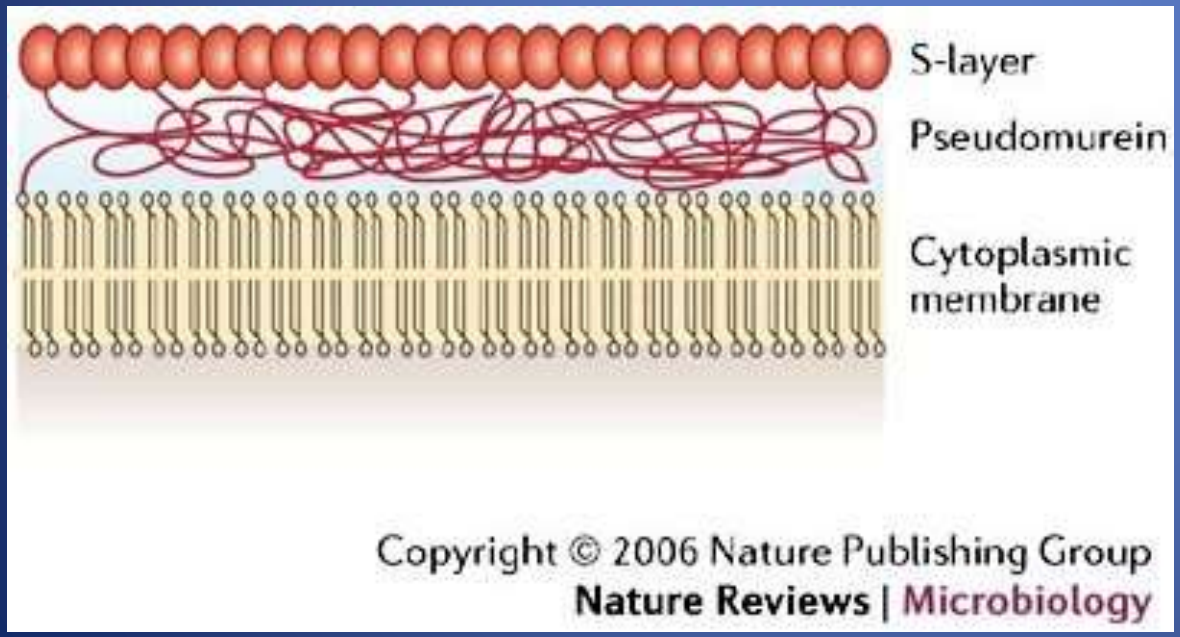
http://www.ucmp.berkeley.edu/archaea/archaeamm.html



NAT (N-Acetyltalosaminuronic acid)



Peptidoglycan



Reference - http://www.nature.com/nrmicro/journal/v4/n7/full/nrmicro1440.html

The atmosphere of the young Earth was rich in ***Ammonia*** and ***Methane***, and was ***probably very hot***. Such conditions, while toxic to plants and animals, can be ***quite cozy for Archaeans***.

Molecular fossils of Archaea in the form of ***Isoprenoid residues*** were first reported from the ***Messel oil shale*** of ***Germany (Michaelis & Albrecht, 1979)***.

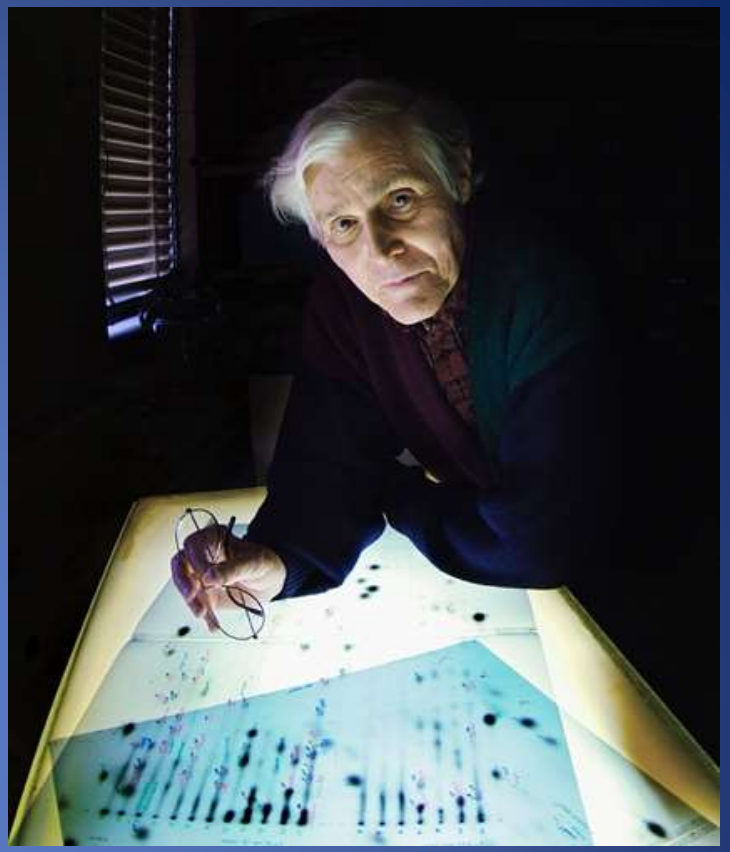
Material from the shale was dissolved and analyzed using a combination of ***Chromatography and Mass Spectrometry***. These processes produce a "***Chemical Fingerprint***". The fingerprint of the Messel shale included ***Isoprene compounds*** identical to those found in archaeans.

Carl Woese was an ***American Microbiologist*** and ***Biophysicist***.

Archaebacteria were not recognized as a distinct form of life from bacteria until 1977, when ***Carl Woese*** and ***George Fox*** determined this through RNA studies.

Dr. Carl Woese spearheaded a study of evolutionary relationships among prokaryotes.

Instead of physical characters, he relied on ***rRNA sequences*** to determine how closely related these microbes were.



Dr. Carl Richard Woese

Born - July 15, 1928
Died - December 30, 2012 (aged 84)

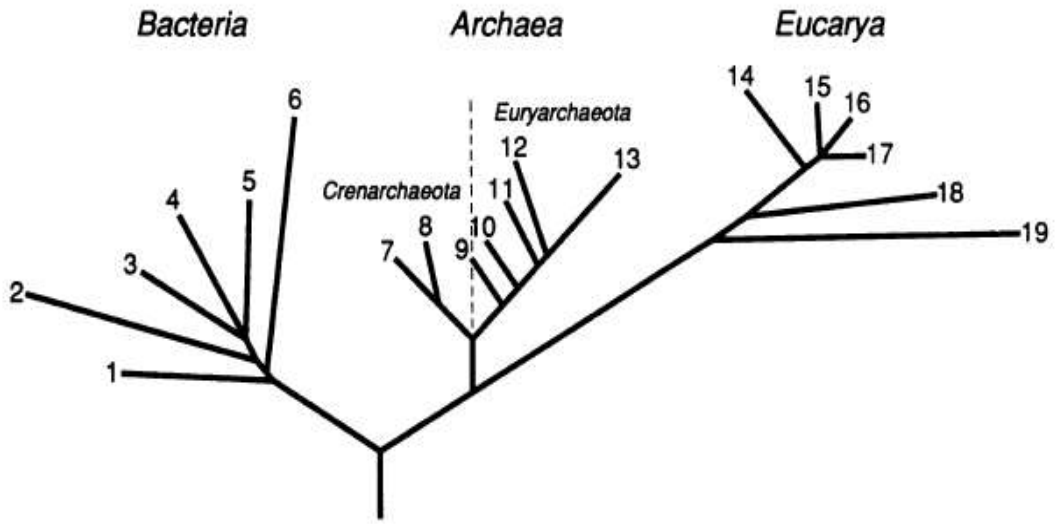
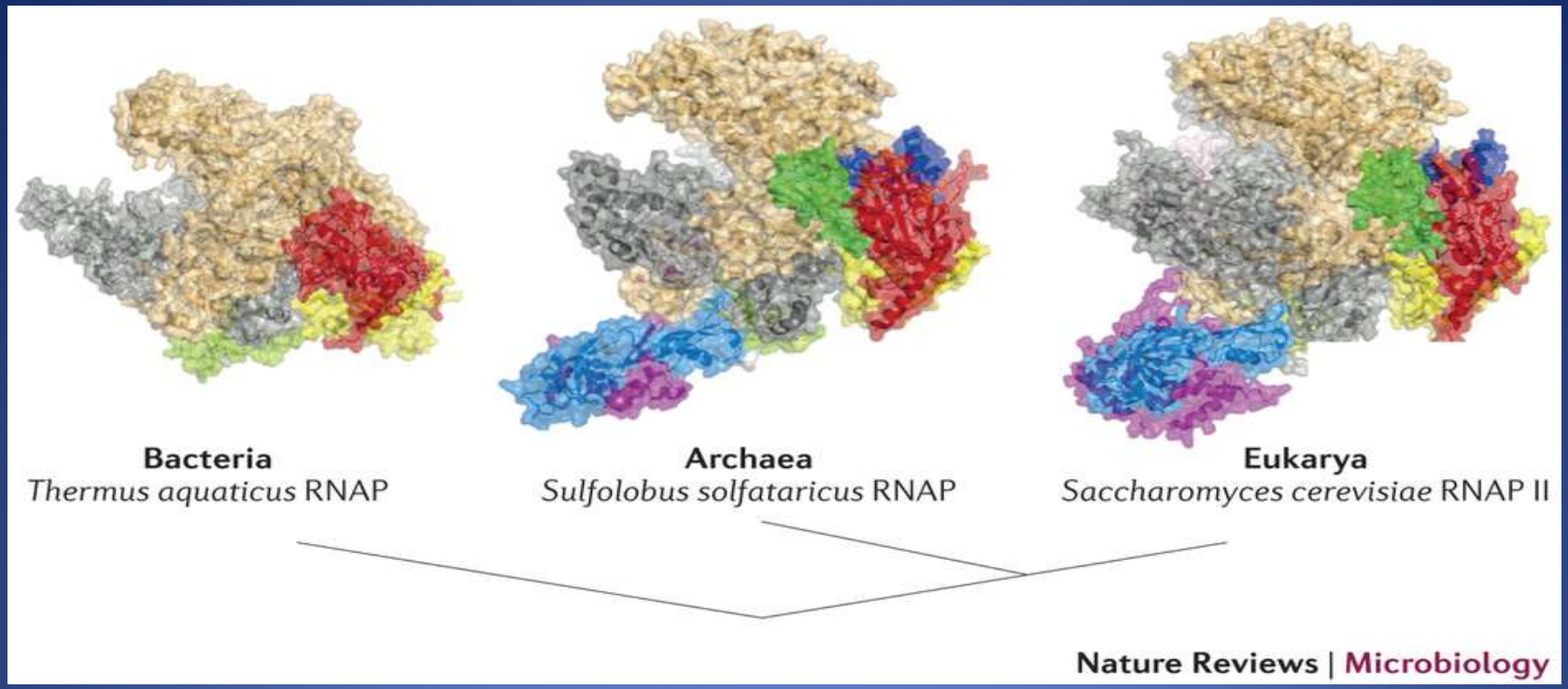


FIG. 1. Universal phylogenetic tree in rooted form, showing the three domains. Branching order and branch lengths are based upon rRNA sequence comparisons (and have been taken from figure 4 of ref. 2). The position of the root was determined by comparing (the few known) sequences of pairs of paralogous genes that diverged from each other before the three primary lineages emerged from their common ancestral condition (27). [This rooting strategy (28) in effect uses the one set of (aboriginally duplicated) genes as an outgroup for the other.] The numbers on the branch tips correspond to the following groups of organisms (2). Bacteria: 1, the Thermotogales; 2, the flavobacteria and relatives; 3, the cyanobacteria; 4, the purple bacteria; 5, the Gram-positive bacteria; and 6, the green nonsulfur bacteria. Archae: the kingdom Crenarchaeota: 7, the genus *Pyrodictium*; and 8, the genus *Thermoproteus*; and the kingdom Euryarchaeota: 9, the Thermococcales; 10, the Methanococcales; 11, the Methanobacteriales; 12, the Methanomicrobiales; and 13, the extreme halophiles. Eucarya: 14, the animals; 15, the ciliates; 16, the green plants; 17, the fungi; 18, the flagellates; and 19, the microsporidia.

Reference - Phylogenetic structure of the prokaryotic domain: The primary Kingdoms, CARL R. WOESE AND GEORGE E. Fox*, Proc. Natl. Acad. Sci. USA Vol. 74, No. 11, pp. 5088-5090, November 1977 Evolution



The structures of RNA polymerases (RNAPs) in bacteria (Thermus aquaticus; Protein Data Bank (PDB) accession 1I6V), Archaea (Sulfolobus solfataricus; PDB accession 2PMZ) and eukaryotes (Saccharomyces cerevisiae RNAP II; PDB accession 1NT9)

Reference - http://www.nature.com/nrmicro/journal/v11/n10/images/nrmicro3124-f2.jpg

Classification of Archae

Domain Archae

1. Kingdom Crenarchaeota

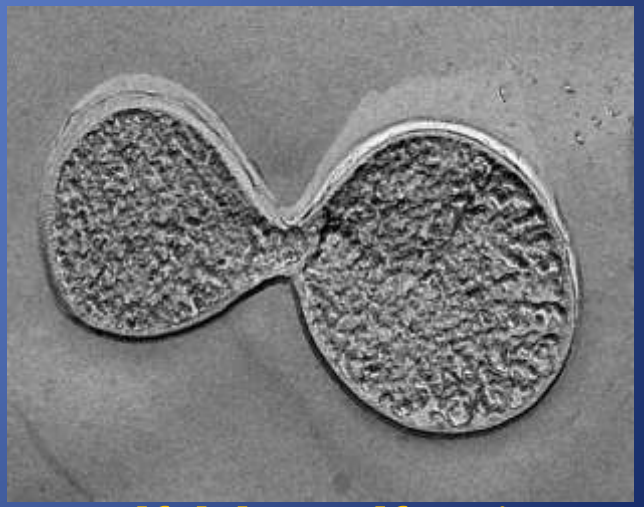
It includes ***Thermophiles, Hyperthermophiles*** and ***Thermoacidophiles.*** These archebacteria are mostly found in the ***Marine environment***.

Affitins

Antibody mimetics and are being developed as an ***alternative to Antibodies*** as tools in biotechnology.

They have also been used as ***specific inhibitors for various enzymes***.

Reference - PMID: 18822295 [PubMed]



Sulfolobus solfataricus

Reference - http://www.sulfosys.com/sulfolobus-solfataricus.html

2. Kingdom Euryarchaeota

This is the most studied division of archaea, and mostly includes ***Methanogens*** and ***Halophiles***.

Microbes in our colons encode enzymes that help digest complex ***dietary polysaccharides*** and ***proteins***.

Bacterial fermentation of polysaccharides produces ***Organic acids***, ***Alcohols***, and ***Gases (CO_2 and H_2)***.

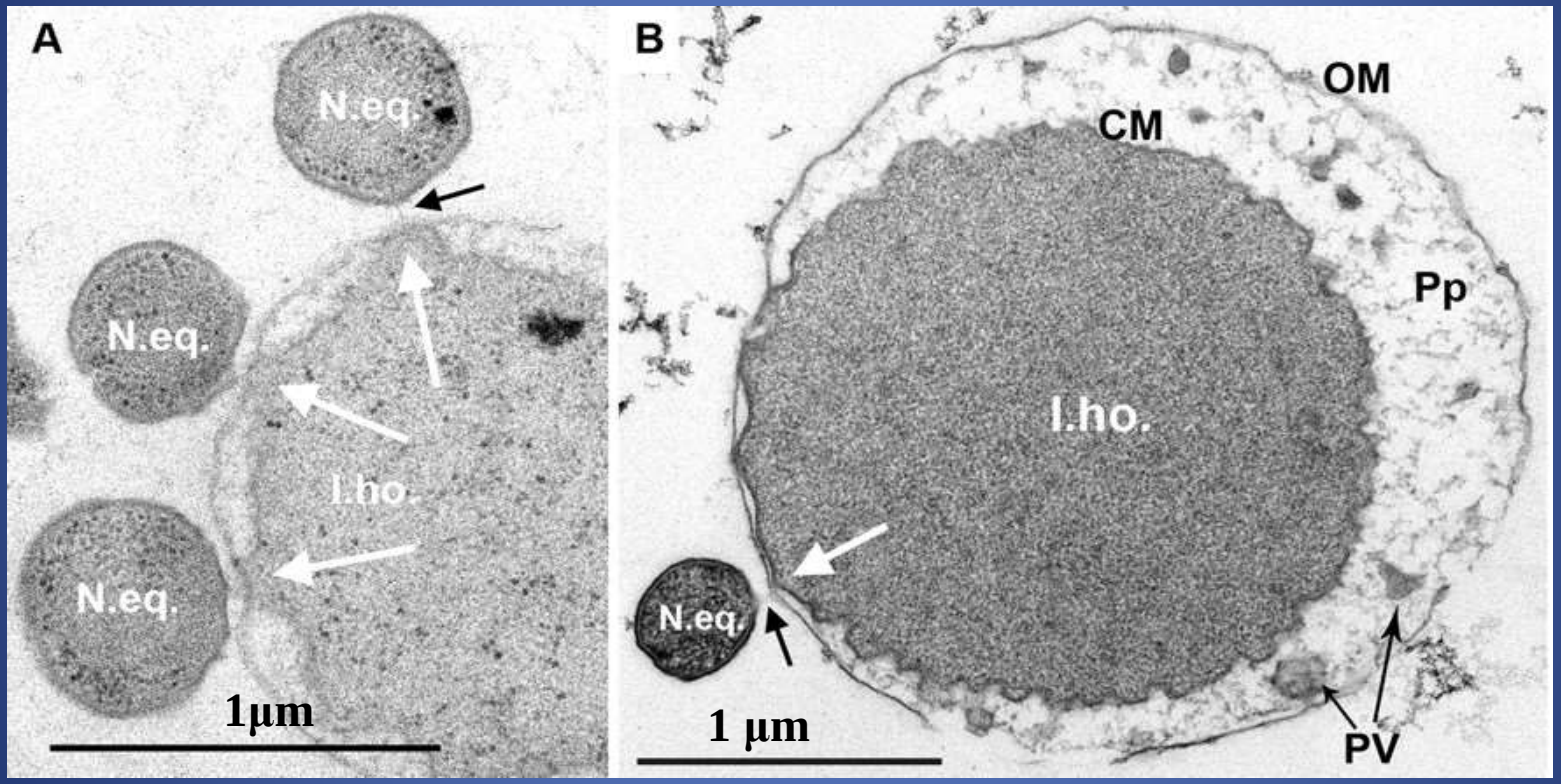
The process of ***Methonogenesis prevents accumulation of H2*** in the human gut and improves the efficiency of microbial fermentation.

Methanobrevibacter smithii

Reference - http://www.corbisimages.com/stock-photo/rights managed/4227859541/methanobrevibacter-smithii-bacteria-sem

3. Kingdom Nanoarchaeota

This kingdom has a single representative member named ***Nanoarchaeum equitans***. This unusual archaea is an **obligate symbiont** of another archaea belonging to the genus ***Ignicoccus hospitalis***.



Transmission electron micrographs of ultrathin sections of ***I. hospitalis*** and ***N. equitans***.

Reference - *Nanoarchaeum equitans* and *Ignicoccus hospitalis*: New Insights into a Unique, Intimate Association of Two Archaea J. Bacteriol. March 1, 2008 vol. 190 no. 5 1743-1750

4. Kingdom Thaumarchaeota

This phylum includes ***Ammonia-oxidizing Archaea (Nitrosopumilus maritimus)***

Play important roles in ***Biogeochemical cycles***, such as the ***Nitrogen cycle*** and the ***Carbon cycle***.

Reference - http://phys.org/news6708.html

5. Kingdom Korarchaeota

This division consists of ***Hyperthermophiles*** found in high temperature ***Hydrothermal environment***.

Only reported Genome sequenced of **Korarchaeota** is from ***Candidatus Korarchaeum cryptofilum***.

Candidatus Korarchaeum cryptofilum was found to have a **blend of Crenarchaeal** and **Euryarchael like genes.**

They **grow well in temperature** around **85^{0}C** and **pH 6.5** in **anaerobic condition.**

Reference - http://www.nature.com/ismej/journal/v4/n3/full/ismej2009126a.html#close

References

1. http://classes.midlandstech.edu/carterp/courses/bio225/chap04/lecture1.htm

2. http://fineartamerica.com/featured/emerald-pool-hot-springs--yellowstone-national-park-gary-whitton.html

3. http://www.ucmp.berkeley.edu/archaea/archaeamm.html#isoprene

4. Phylogenetic structure of the prokaryotic domain: The primary Kingdoms, CARL R. WOESE AND GEORGE E. Fox*, Proc. Natl. Acad. Sci. USA Vol. 74, No. 11, pp. 5088-5090, November 1977 Evolution

5. http://www.nature.com/nrmicro/journal/v11/n10/images/nrmicro3124-f2.jpg

6. http://www.sulfosys.com/sulfolobus-solfataricus.html

7. http://www.corbisimages.com/stock-photo/rights managed/4227859541/methanobrevibacter-smithii-bacteria-sem

8. *Nanoarchaeum equitans* and *Ignicoccus hospitalis*: New Insights into a Unique, Intimate Association of Two Archaea J. Bacteriol. March 1, 2008 vol. 190 no. 5 1743-1750

9. http://phys.org/news6708.html

10. http://www.nature.com/ismej/journal/v4/n3/full/ismej2009126a.html#close