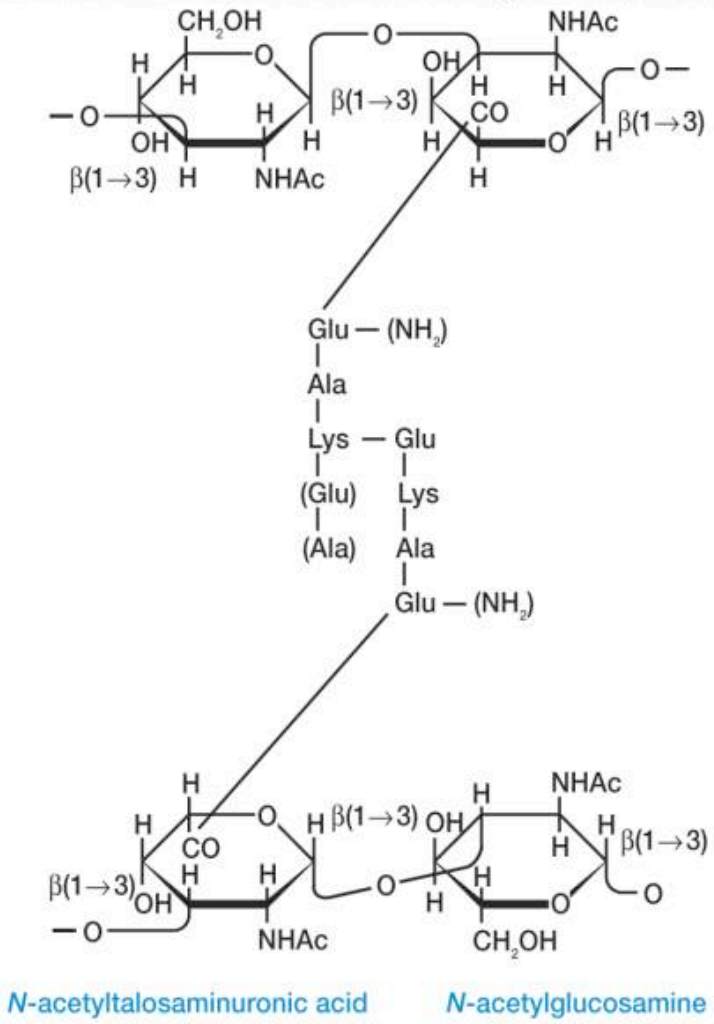
Distinctive characteristics of Archaea

- Cell wall
- Lipids/membrane
- Information processing
- Physiological adaptations to extreme environments



Pseudomurein

Fig. 20.2 Substitutes for N-Acetylmuramic acid (NAM) of peptidoglycan

Gram+ vs. Gram- Archaea

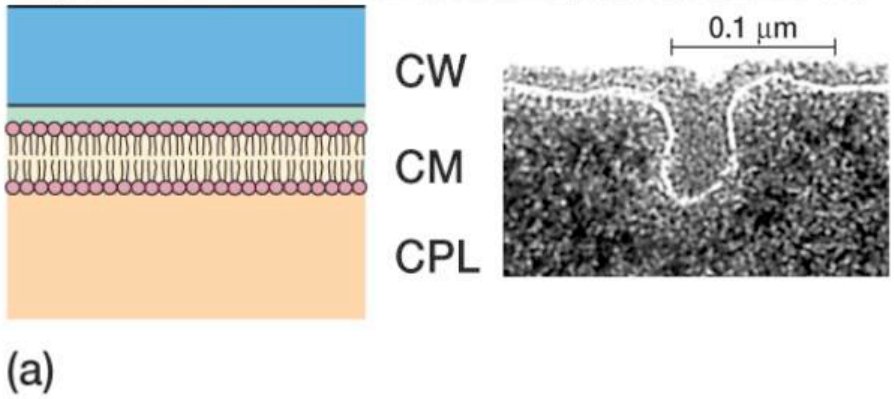


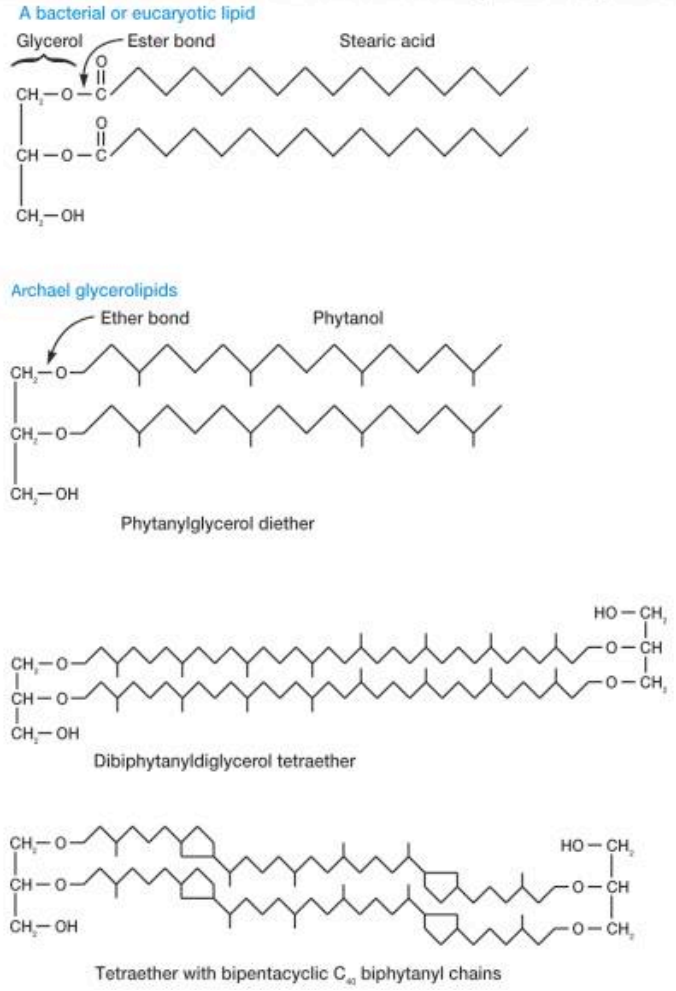
Fig. 20.1

Gram+

Cell wall of pseudomurein or other complex carbohydrate

Gram-

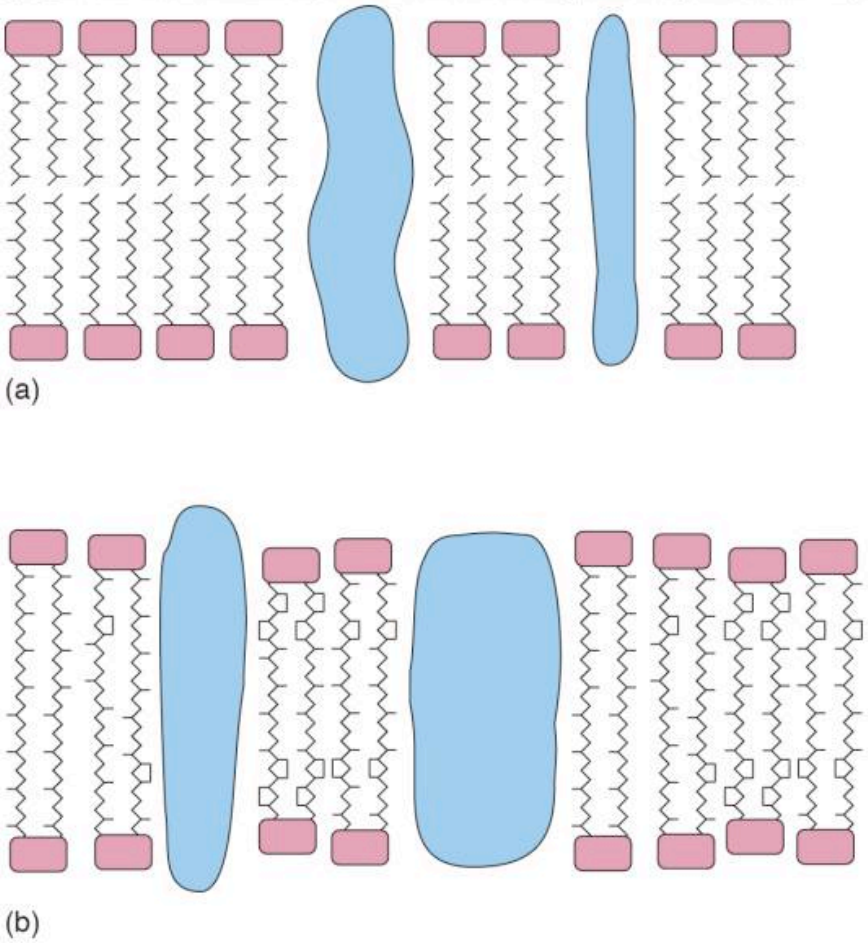
No outer membrane
No cell wall
Thick protein/glycoprotein coa



Archaeal Lipids

- Fatty acid attached by ether not ester links
- Varying lengths of carbon side chains- 20 or 40 carbon

Fig. 20.3



Flexible

Rigid- gives membrane stability to thermophiles

Fig. 20.5

Archaea

Similarities to prokaryotes

- Size
- Shape
- Lack nucleus
- Single chromosome
- Genes in operons
- No introns

Similarities to eukaryotes

- Few plasmids
- RNA polymerase/promoters
- Translation machinery: ribosome and tRNA

Sequencing of *Methanococcus jannaschii* in 1992
56% of genes not similar to bacteria or eukaryotes!

Major groups of Archaea

- Methanogenic archaea
- Archaeal sulfate reducers
- Extremely halophilic archaea
- Cell wall-less archaea
- Extremely thermophilic S^0-metabolizers

Methanogens

- Largest group of Archaea
- Form methane (CH_4) from CO_2 or other compounds (e.g. formate, methanol, acetate)
- Strict anaerobes
- Found in a variety of anaerobic environments rich in organic matter
- Causes cows to belch!
- Methane: energy source vs. greenhouse gases

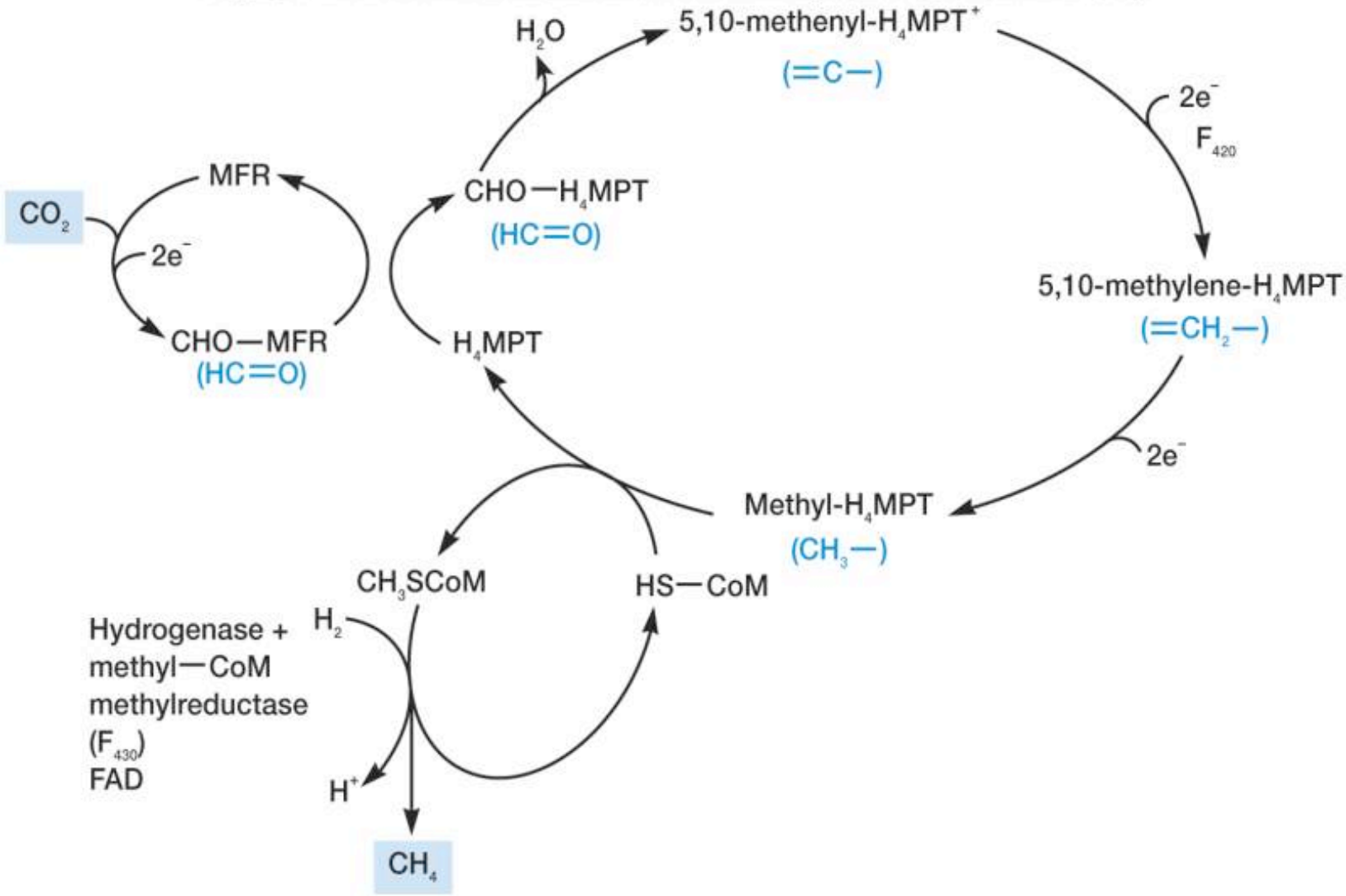
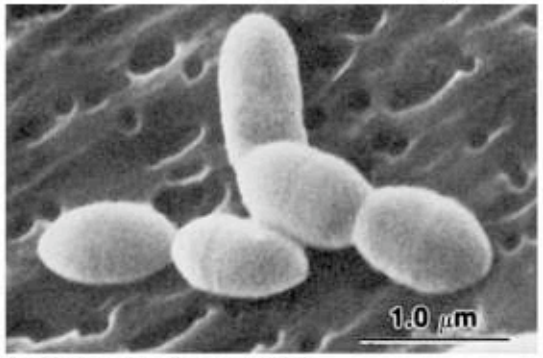
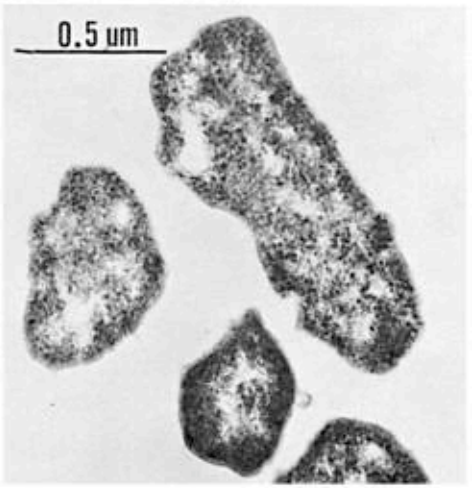


Fig. 20.12

(a) *Methanosprilillum hungatei*



(b) *Methanobrevibacter smithii*



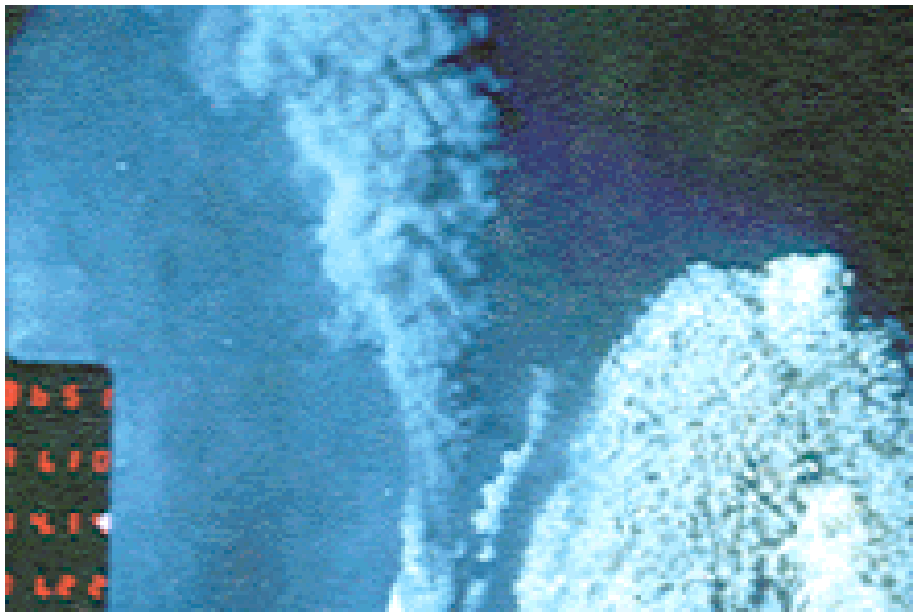
(c) *Methanogenium marisnigri*

(d) *Methanosarcina mazei*

Fig. 20.10

Sulfate-reducing archaea

- Only genus is *Archaeoglobus*
- Reduces sulfates to produce sulfide (H_2S)
- Extremely thermophilic (optimum=83˚C)
- Strictly anaerobic
- Isolated from a deep sea thermal vent

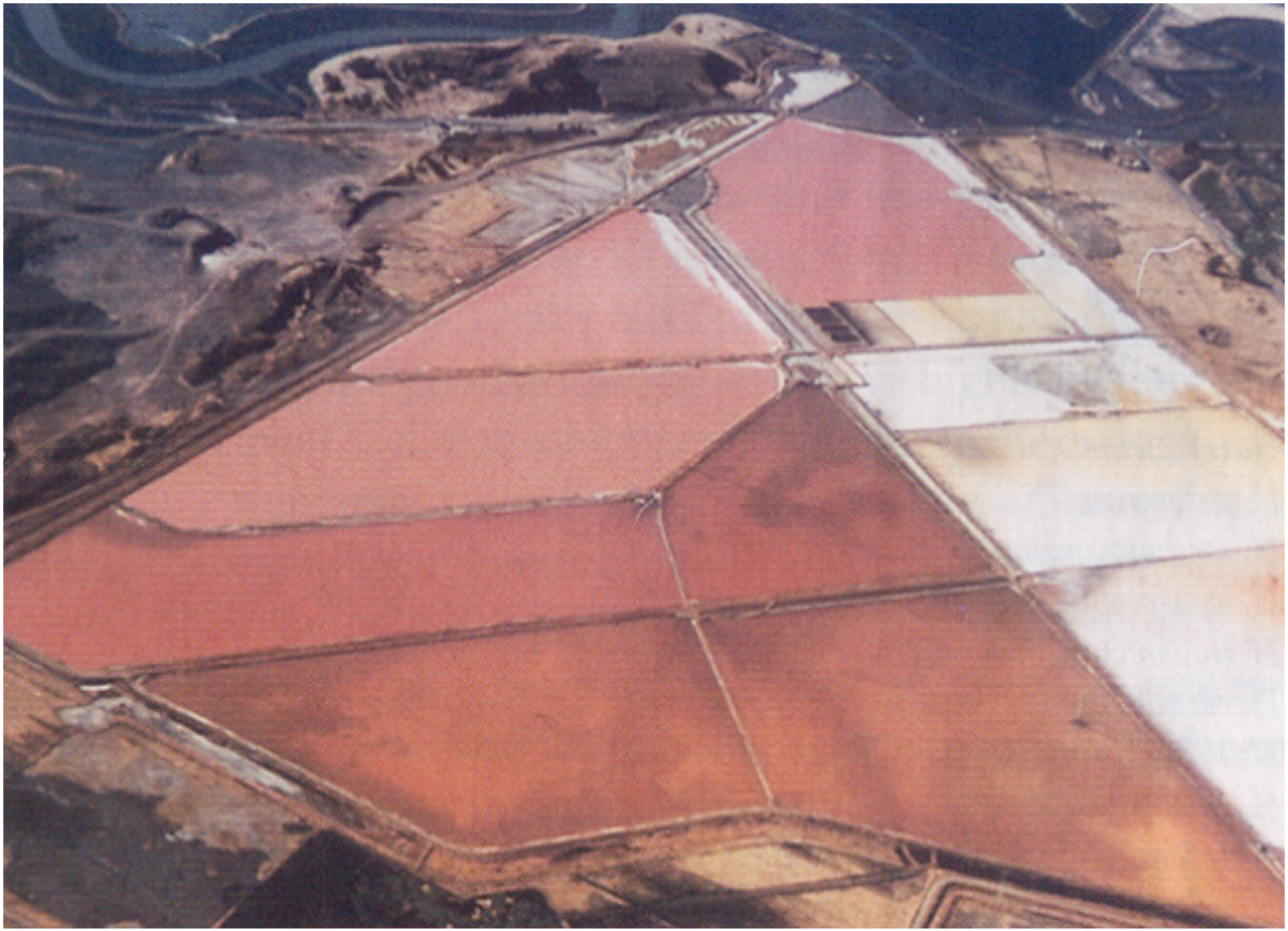


Extremely thermophilic S^0-metabolizers

- Obligately thermophilic (70-110˚C)
- Mainly strict anaerobes
- Can be acidophilic
- S^0 reduce to sulfide
- Hot springs of Yellowstone

Extreme halophiles

- Require high NaCl concentration
  - Require 1.5 M, optimum 3-4 M
- Primarily aerobic
- Carotenoids give reddish color
- Bacteriorhodopsins capture light for energy in anaerobic respiration



Cell wall-less archaea

- *Thermoplasma* and *Picrophilaceae*
- Resistant to antibiotics
- Like warm, acidic environments
- *Thermoplasma* isolated from coal refuse piles
  - 55-59˚C, pH 1-2
- *Picrophilaceae* can grow at pH=0