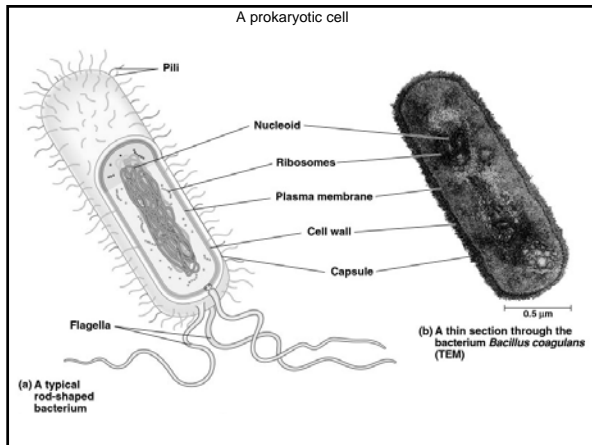


Comparing Prokaryotic and Eukaryotic Cells

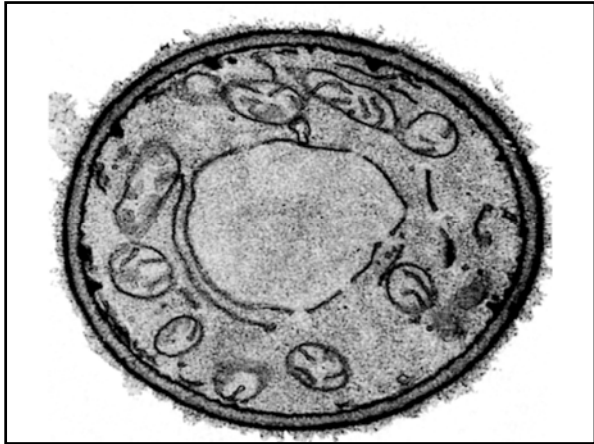
Basic unit of living organisms is the cell; the smallest unit capable of life.

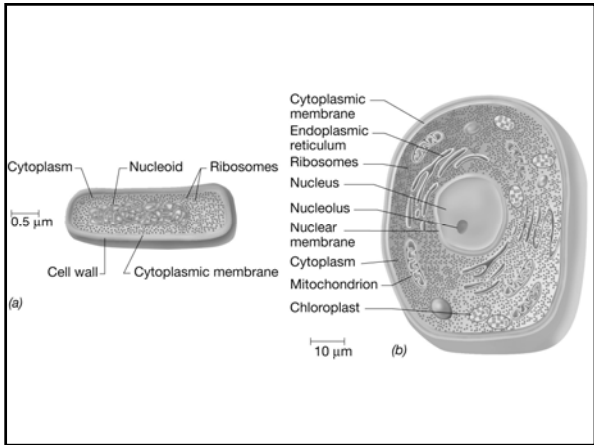
“Features” found in all cells:

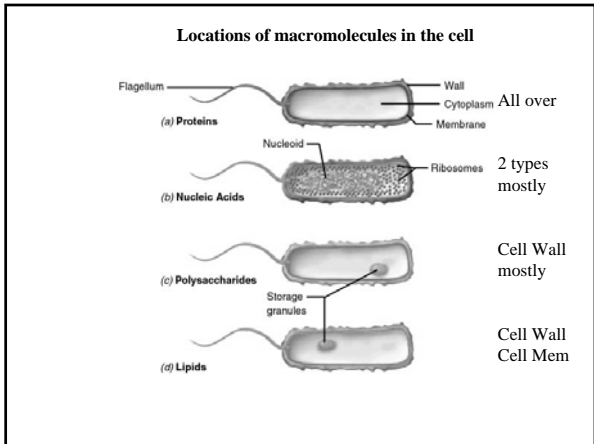
- Ribosomes
- Cell Membrane
- Genetic Material
- Cytoplasm
- ATP Energy
- External Stimuli
- Regulate Flow
- Reproduce

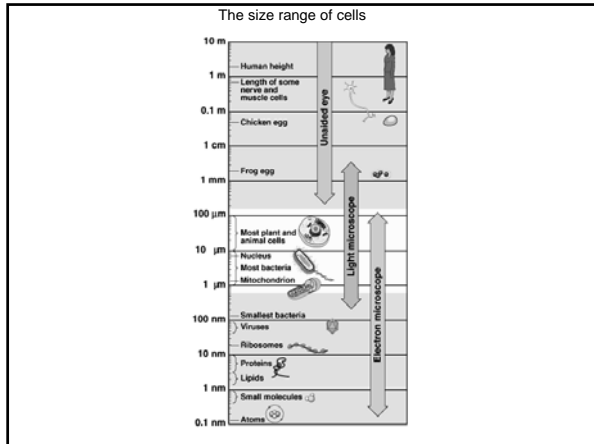


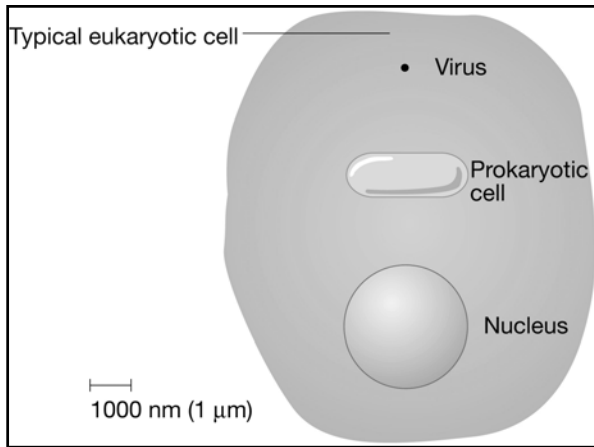


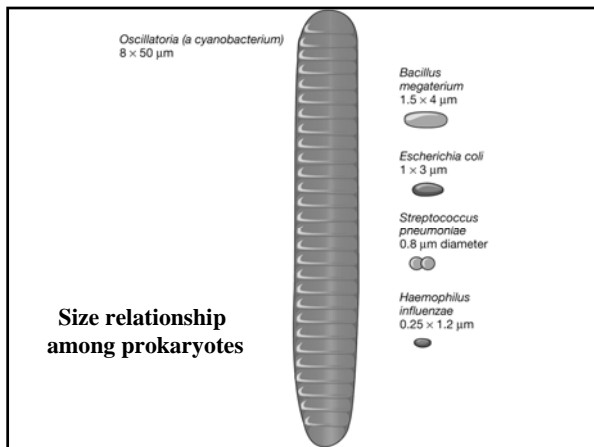


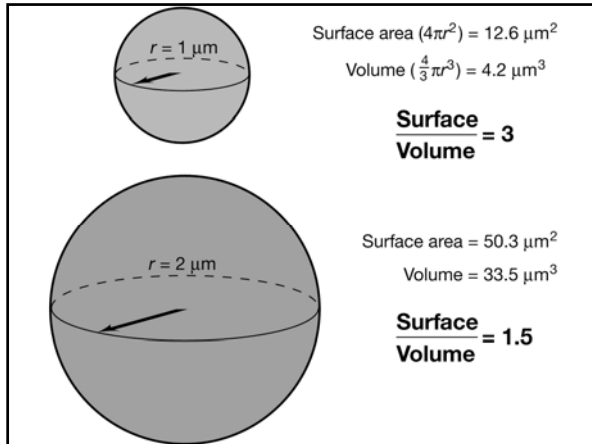


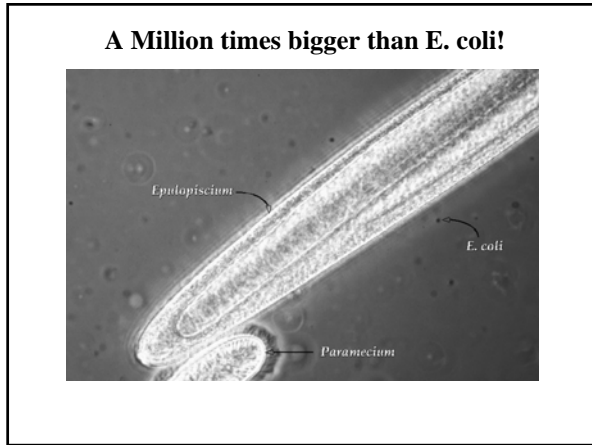


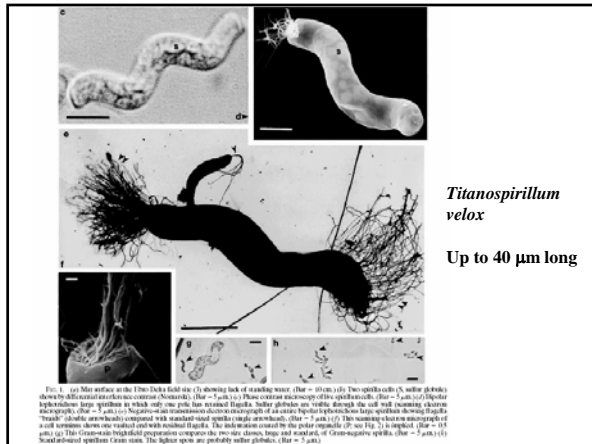


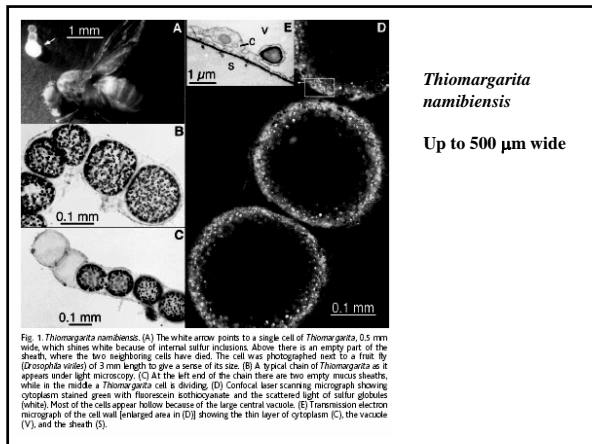


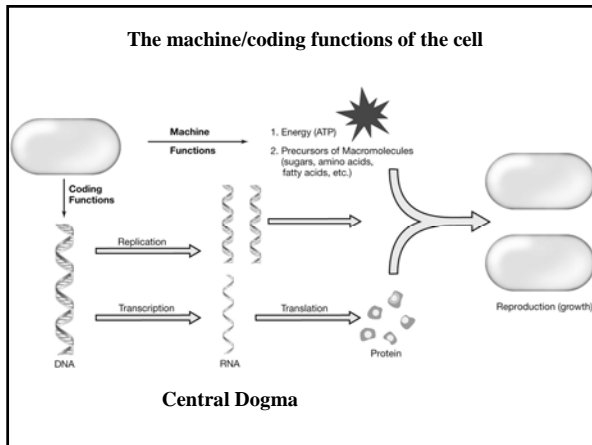












Comparing Prokaryotic and Eukaryotic Cells

Basic chemical components/elements of a cell

CHOPKNS CaFe (its) Mg (ood)

TABLE 2.2 Chemical composition of a prokaryotic cell* **Rem: 70-85% Water**

Molecule	Percent of dry weight ^b	Molecules per cell	Different kinds
● Total macromolecules	96	24,610,000	-2500
● Protein	55	2,350,000	-1850
● Polysaccharide	5	4,300	2 ^c
● Lipid	9.1	22,000,000	4 ^d
● Lipopolysaccharide	3.4	1,430,000	1
● DNA	3.1	2.1	1
● RNA	20.5	255,500	660 ^d
Total monomers	3.0		-350
Amino acids and precursors	0.5		-100
Sugars and precursors	2		-50
Nucleotides and precursors	0.5		-200
Inorganic ions	1		18
Total	100%		

^a Data from Neidhardt, F. C., et al. (eds.), 1996. *Escherichia coli* and *Salmonella typhimurium*—*Cellular and Molecular Biology*, 2nd edition. American Society for Microbiology, Washington, DC.

^b Dry weight of an actively growing cell of *E. coli* is 2.8×10^{-13} g; total weight (70% water) = 9.5×10^{-13} g.

^c Assuming peptidoglycan and glycogen to be the major polysaccharides present.

^d There are several classes of phospholipids, each of which exists in many kinds because of variability in fatty acid composition between species and because of different growth conditions.

Protein ~50%
Lipid ~10% → **Cell Wall 10-20%**
RNA ~20%
DNA ~3-4%

Take Home Message:

Proteins are #1 by weight

Lipids are #1 by number

Peptidoglycan is 1 jumbo molecule

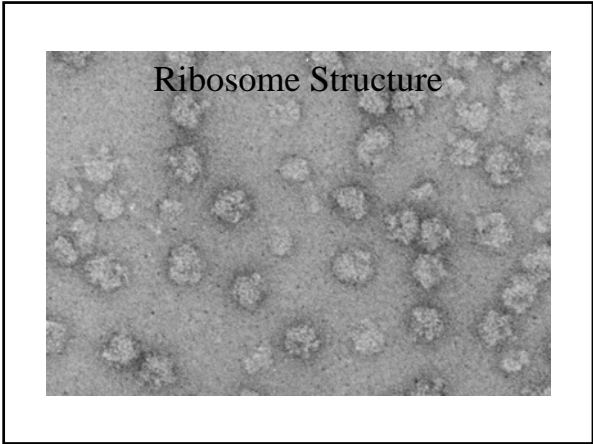
Comparing Prokaryotic and Eukaryotic Cells

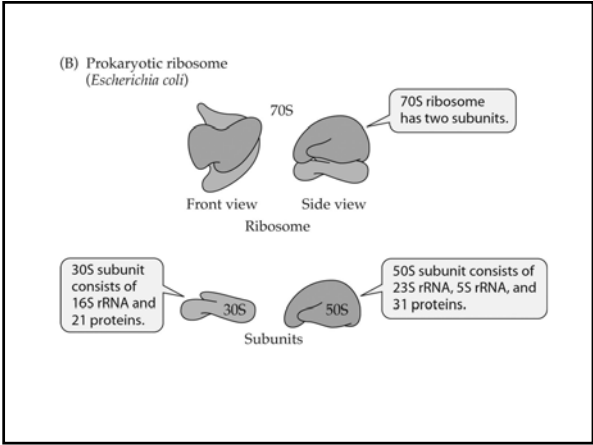
Classification of prokaryotic cellular features:
Invariant (or common to all)

⇒ **• Ribosomes: Sites for protein synthesis – aka the grand translators**

• Cell Membranes: The barrier between order and chaos

• Nucleoid Region: Curator of the Information





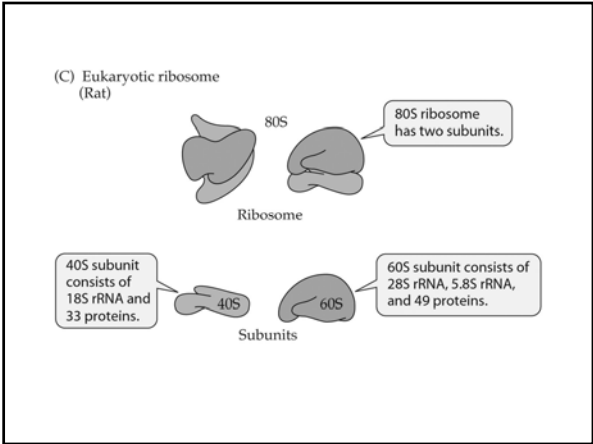
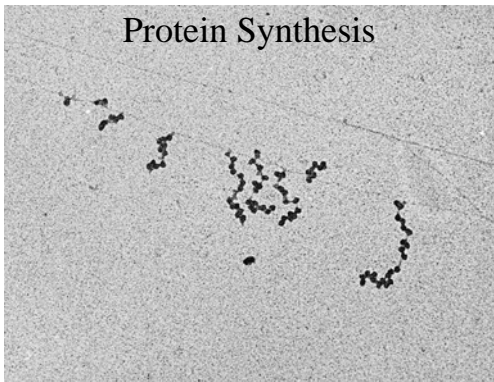


TABLE 7.4 Ribosome structure^a

Property	Prokaryote	Eukaryote
Overall size	70S	80S
Small subunit	30S	40S
Number of proteins	~21	~30
RNA size (number of bases)	16S (1500)	18S (2300)
Large subunit	50S	60S
Number of proteins	~34	~50
RNA size (number of bases)	23S (2900) 5S (120)	28S (4200) 5.8S (160) 5S (120)

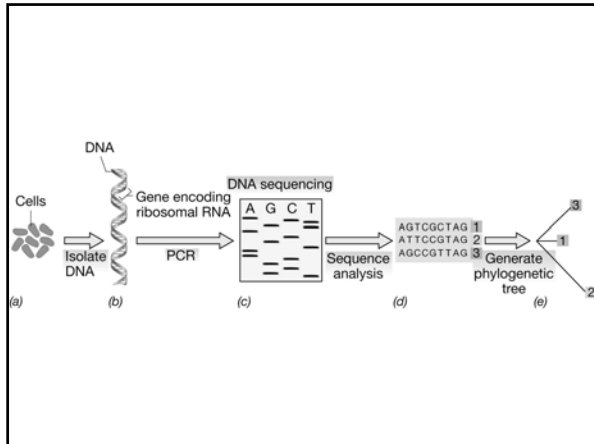
S= Svedberg; a sedimentation coefficient that is NOT ADDITIVE!!!

Protein Synthesis



Importance of a Molecular Biological Approach

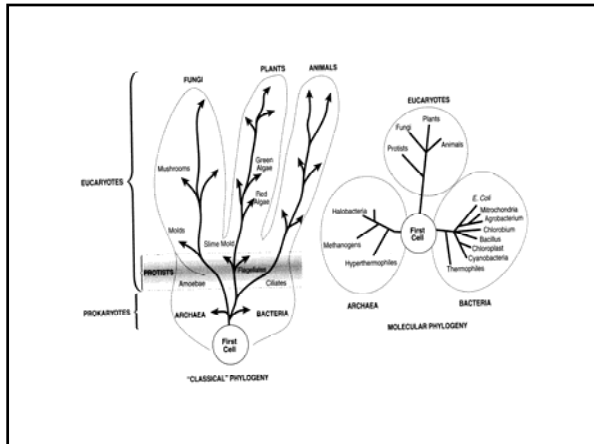
- **Traditional culturing** techniques isolate ~1% of the total bacteria in marine ecosystems, thereby severely underestimating diversity and community structure.
- Because nutrient-rich **culture media** have been historically used during enrichment procedures, bacteria which may be dominant in natural communities are selected against in favor of copiotrophic (weedy) bacteria.
- **SSU rRNAs** and their respective genes are excellent descriptors of microbial taxa based on phylogeny.

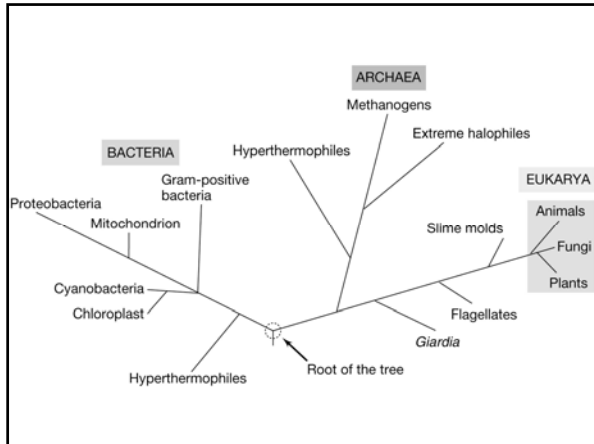


Regarding Molecular Phylogeny

The Root of the Problem: Unlike zoology and botany, microbiology developed without the knowledge of phylogenetic relationships among the organisms studied.

- Milestone #1: Zuckerkandl and Pauling (1965) "Semantides" (i.e., molecules as documents of evolutionary history).
- Milestone #2: Pace (1986) Applied phylogeny concept to microbial ecology's need to take a census.
- Milestone #3: Woese (1987) Applied phylogeny concept to redefine microbial systematics or the need to understand microbial genealogy.





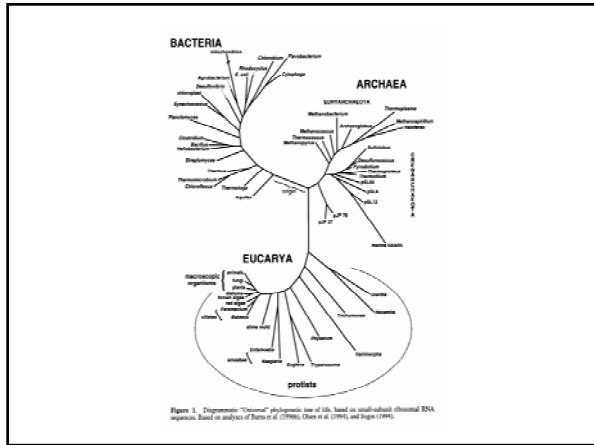


Figure 1. Diagram of "The tree" phylogenetic tree of life, based on small-subunit ribosomal RNA sequences, based on analysis of Woese et al. (1990), Olsen et al. (1994), and Inge (1994).

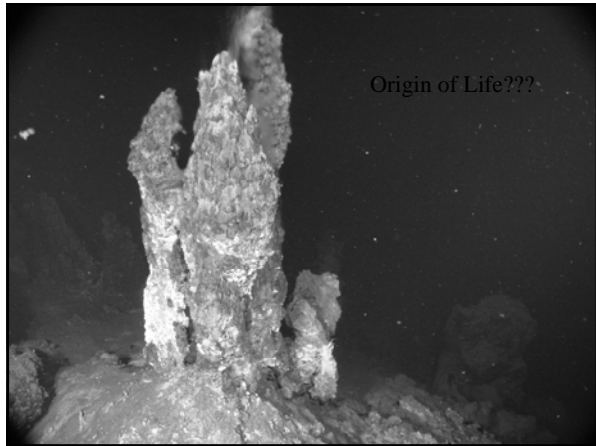
Some Lessons from the BIG TREE: Map of the Biological Record

Single origin for all life on Earth...

- Central Dogma intact
- ATP and PMF are universal themes
- Uniformity among chiral carbon compounds (sugars & AAs)
- Hot start origin...

General topology implies:

- Three "primary lines of evolutionary descent"
- The Eucarya "nuclear" lineage almost as old as the prokaryote lines
- Prokaryotes split between *Bacteria* and *Archaea*
- Shown for only a limited number of representative org's
- Mitochondria and chloroplasts proven to be of bacterial origin



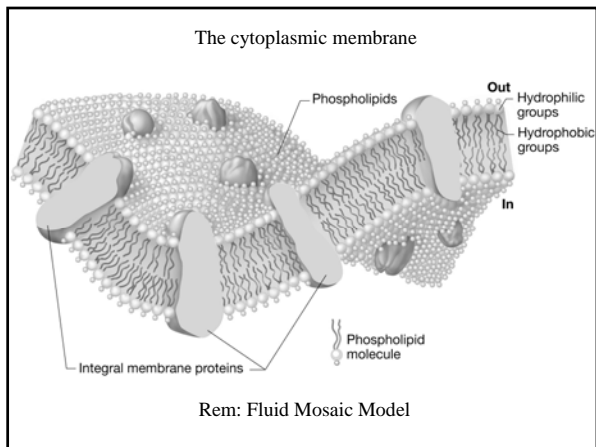
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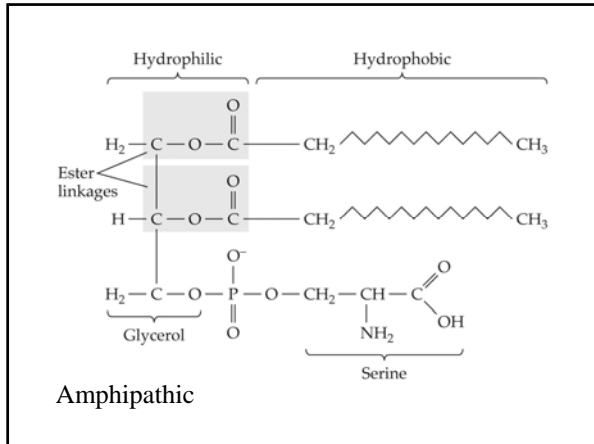
Classification of prokaryotic cellular features:
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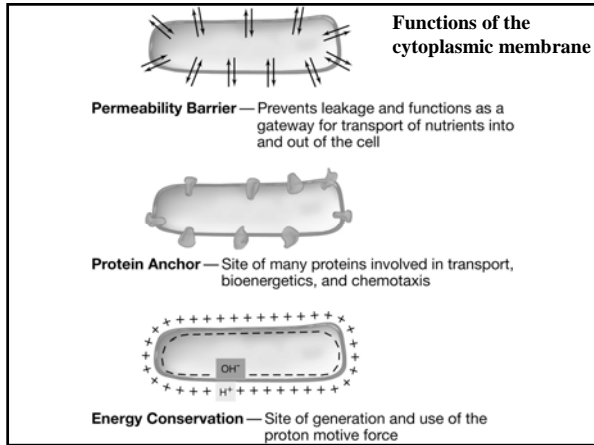
- **Ribosomes: Sites for protein synthesis – aka the grand translators**

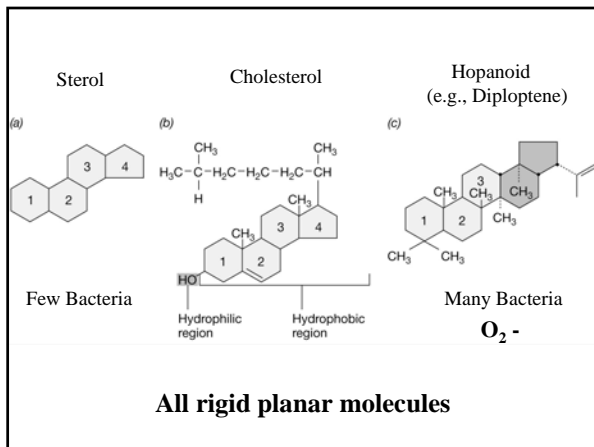
⇒ • **Cell Membranes: The barrier between order and chaos**

- **Nucleoid Region: Curator of the Information**

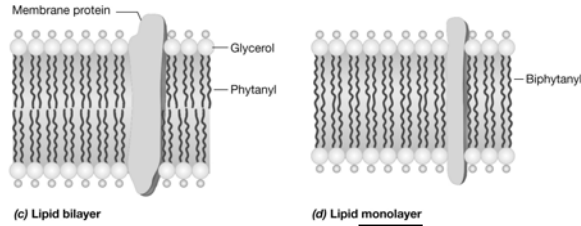




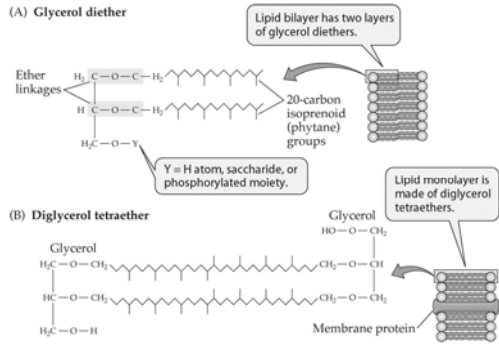




Major lipids of *Archaea* and the structure of archaeal membranes



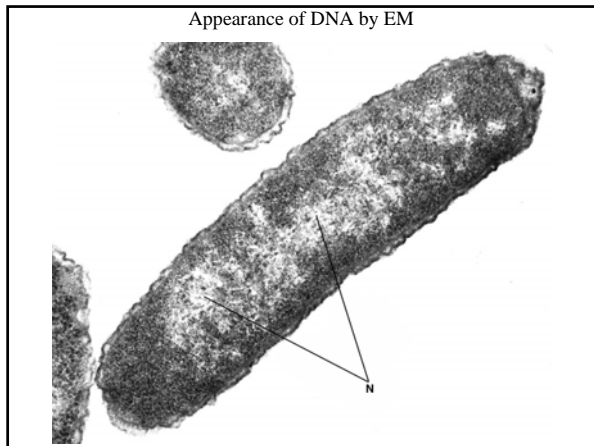
Archaeal cell membrane structure

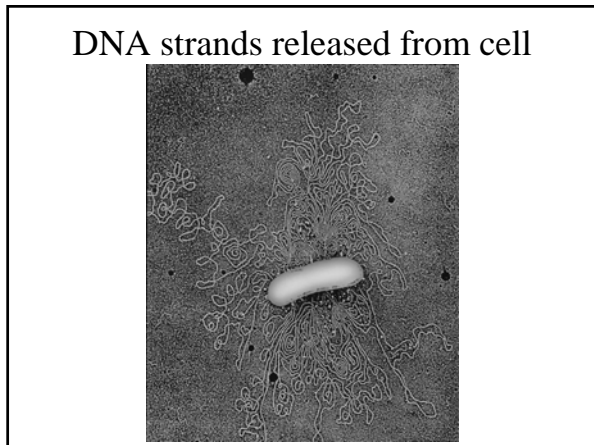


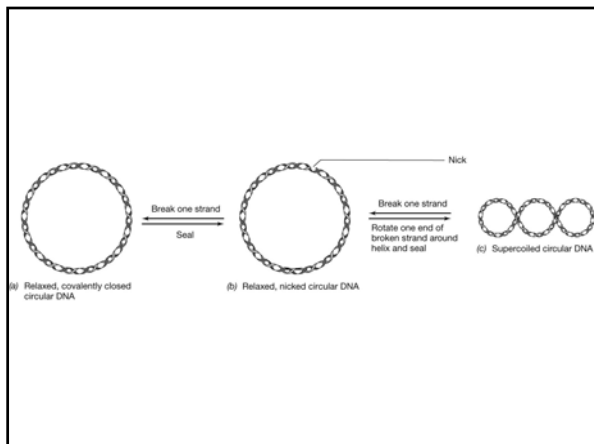
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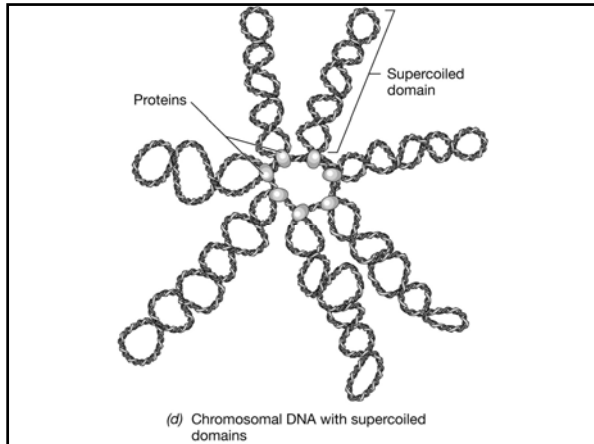
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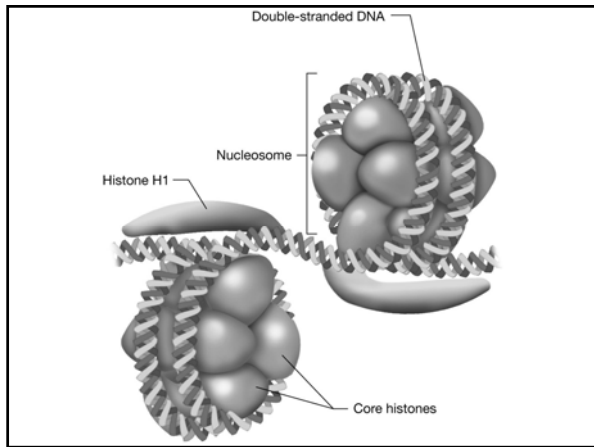
- Ribosomes: Sites for protein synthesis – aka the grand translators
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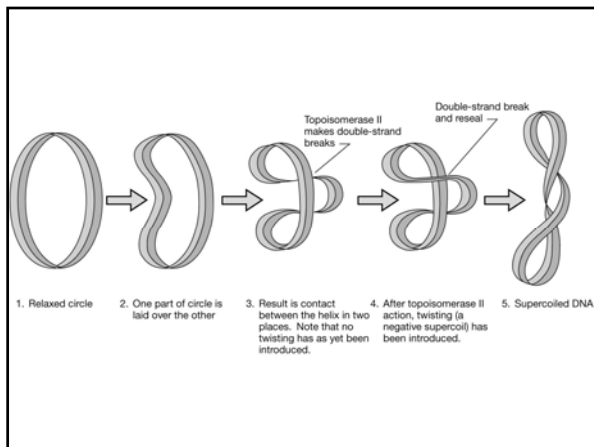












Overview of DNA replication

