

Ch 27
**Prokaryotes
 and the
 Origins of
 Metabolic
 Diversity**

AP Biology
 Mrs. King

Bacteria on the point of a pin

The World of Prokaryotes

- They are everywhere, estimated to be 400,000 to be 4 million species
- Differ from eukaryotic cells, how?
- Pathogens, decomposers, symbiotes

Bacteria and Archaea

- Archaea:
 - extreme environments, first to evolve?
- Bacteria (eubacteria)
 - more “modern” form, most numerous
- Two **domains** differ in structure, biochemical, and physiological characteristics

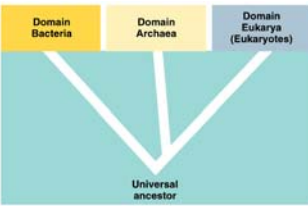




Figure 27.9x Bacterial and fungal colonies



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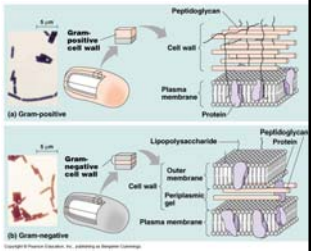
Structure, Function, & Reproduction

- Cell walls present in almost all prokaryotes
- Most are motile
- Genomic organization fundamentally different from eukaryotes
- Grow and evolve rapidly



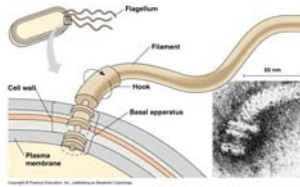
Cell Walls

- Maintain shape
- Protect
- Role in hypotonic environment
- Chemically different from eukaryotic cell walls



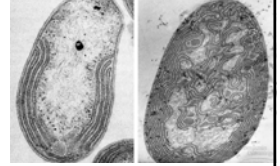
Motility: use one of three mechanisms to move

- **Flagella:** rotate rather than whip back and forth
- **Filaments:** in spirochetes, cause cell to spiral
- **Gliding:** secrete slimy chemicals, may use flagellar “motors” w/out flagella



Prokaryote vs. Eukaryote Organization

- Prokaryote use specialized membranes: cell respiration and photosynthesis
- **Genophore:**
 - bacterial chromosome, few histones, circular
- Plasmid, usually not essential
- Ribosomes (different proteins and rRNA composition)



Reproduce by Binary Fission

- Genetic recombination possible
 - transformation, conjugation, and transduction
- Endospores
 - resistant cell, able to survive boiling water, long dormancy possible
 - ex. *anthrax endospore*



Nutritional and Metabolic Diversity

Four categories of obtaining energy:

1. **Photo**autotrophs
2. **Chemo**autotrophs
3. **Photo**heterotrophs
4. **Chemo**heterotrophs

- Saprobies vs. parasites
- Nitrogen metabolism
- Obligate aerobes, facultative anaerobes, obligate anaerobes

Table 27.1 Major Nutritional Modes

Mode of Nutrition	Energy Source	Carbon Source	Types of Organisms
Autotroph			
Photo-autotroph	Light	CO ₂	Photosynthetic prokaryotes, including cyanobacteria; plants; certain protists (algae)
Chemo-autotroph	Inorganic chemicals	CO ₂	Certain prokaryotes (for example, <i>Sulfolobus</i>)
Heterotroph			
Photo-heterotroph	Light	Organic compounds	Certain prokaryotes
Chemo-heterotroph	Organic compounds	Organic compounds	Many prokaryotes and protists; fungi; animals; some parasitic plants

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Evolutionary Importance

- First evolved 3.5-4.0 billion years ago
- Origin of photosynthesis: first photosynthetic pigments may have originated to protect cells from excess uv light
- First photosynthetic bacteria (cyanobacteria) evolved 2.5-3.4 billion years ago

