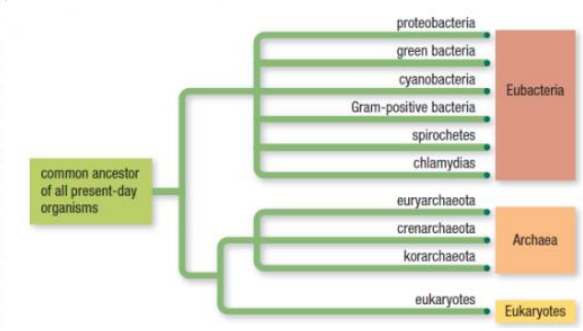
The Prokaryotes: Archaea & Eubacteria

DOMAIN ARCHAEA

- Contains only the kingdom Archaea
- Characteristics:
    - Differ from eubacteria in that their cell membrane and cell wall LACK: peptidoglycan
    - Inhabit extreme environments
- Three branches



EURYARCHAEOTA SUBGROUP

Methanogens

- live in low oxygen environments (sediments, digestive tracts of mammals, etc) · Generate energy by converting chemical compounds into methane gas, which is released into the atmosphere

Halophiles

- live in highly saline environments ·
- Aerobic (need oxygen for cellular respiration)
- Some use light as secondary energy source

Extreme thermophiles

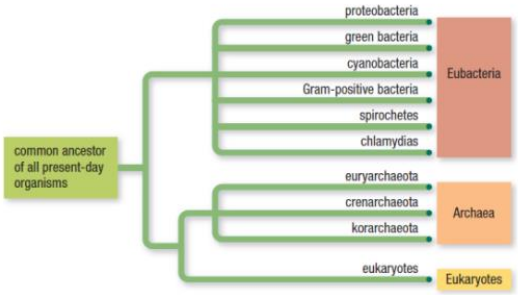
- Live in extremely hot environments (hot springs, hydrothermal vents)
- Optimal temperature for growth is 70 °C to 90°C

Psychrophiles

- Cold loving (live in Arctic oceans and cold ocean depths) · Optimal temperature for growth is −10 °C to −20 °C

DOMAIN EUBACTERIA

- Contains only the kingdom
- Sometimes referred to as just "bacteria"
- Eubacteria means "true bacteria"
- Twelve branches (only six groups shown)



IMPORTANT BACTERIA GROUPS

Proteobacteria

- Ancestors of mitochondria
- Some photosynthetic (different from plants), some nitrogen fixing
- Responsible for many disease (bubonic plague, gonorrhea, dysentery, and some ulcers)

Cyanobacteria

- Ancestors of chloroplasts
- Photosynthetic

Gram−positive bacteria

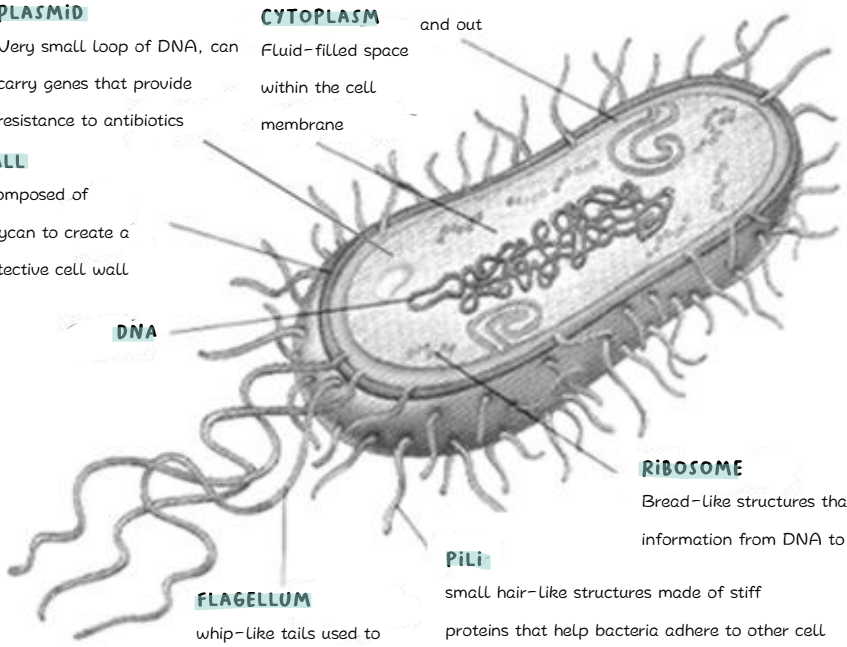
- Commonly seen as both)helpful (food production) and harmful bacteria (diseases)

CELL MEMBRANE
Plasma membrane, forms a barrier between the cell and its environment, allows selective movement of material in and out

PLASMID
Very small loop of DNA, can carry genes that provide resistance to antibiotics

CYTOPLASM
Fluid-filled space within the cell membrane

CELL WALL
Mostly composed of peptidoglycan to create a rigid, protective cell wall



DNA

RIBOSOME
Bread-like structures that translates the information from DNA to make proteins

PILI
small hair-like structures made of stiff proteins that help bacteria adhere to other cell and surfaces

FLAGELLUM
whip-like tails used to propel bacteria

CAPSULE
Sticky material surrounding cell to reduce water loss, resist high temperature and block antibiotics

CHROMOSOME
Single loop of DNA necessary for vital cell function, found in region called nucleoid

BACTERIA CAN BE CLASSIFIED BY THEIR SHAPE

Round

- Single (plural)
  - Coccus (cocci)
- Pairs
  - Diplococcus
- Chain
  - Streptococcus
- Clusters
  - Staphylococcus

Rod

- Single
  - Bacillus
- Pairs
  - Diplobacillus
- Chain
  - Streptobacillus

Spiral

- Single (plural)
  - Spirillum (spirilli)

WHY ARE BACTERIA SO SUCCESSFUL?

1. Diversity in metabolism

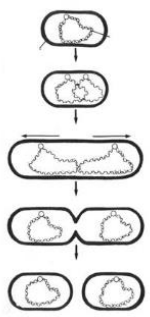
- Some are autotrophic
  - Produce organic (complex carbon based) molecules from simple inorganic molecules
  - Energy from carbon dioxide, water, minerals, hydrogen, sulfur, iron
- Most are heterotrophic
  - Use organic molecules formed by other organisms (bacteria that obtain carbon from dead organisms are called saprotrophs)
  - Energy from sugars, fats, and proteins

2. They can live with or without oxygen
    - Obligate aerobes:
        - need oxygen for cellular respiration (the process of getting energy from food)
    - Facultative aerobes:
        - can live with or without oxygen
        - Oxygen present -> aerobic respiration
        - Oxygen absent -> anaerobic fermentation
    - Obligate anaerobe:
        - Cannot live in the presence of oxygen

3. They occupy every ecological niche
    - Producers: source of food for other organisms
    - Decomposers: break down dead or decaying organisms
    - Can form symbiotic relationships
        - Mutualism (benefits both)
        - commensalism (one benefits, doesn't affect other)
        - Parasitism (one benefits, one affected negatively)
4. They can form protective encasements called endospores
    - Forms around the chromosome when the cell is under stress
    - Remaining cellular components falls away
    - Small dormant endospore that can withstand extreme environments for long periods of time

REPRODUCTION IN BACTERIA

1) Asexual Reproduction - by binary fission
- One parent cell divides into two genetically identical daughter cells
    1. Chromosome and plasmid replicate
    2. Cell elongates
    3. Septum or wall forms to divide the cell
    4. Cytokinesis
- Error in DNA replication create mutations (provides genetic diversity)



2) Sexual Reproduction
- DNA is exchanged between two individuals

A) Conjugation
- Two cells share genetic information when one cell copies a gene from one plasmid and transfers it to a second cell
- The DNA is transferred through connecting pili

B) Transformation
- A whole strand of DNA is transferred from a dead bacteria to a living one.
- Physical contact is not required
- Also called horizontal gene transfer
- Newly "transformed" bacteria can now perform functions of the dead bacteria
- Example: could now become pathogenetic (disease-causing) or resistant to certain antibiotics