

## Section 18.4: Archae and Bacteria

### I. Diversity of Prokaryotes

- Prokaryotes are *unicellular* organisms that do not have a *nucleus* or other *membrane*-bound organelles.
- They are classified in *two* kingdoms: *archaea* and *bacteria*.

### II. What is a Bacterium?

- A bacterium is a very *small cell*.
- Most are seen with a *compound light* microscope, but a few can only be seen by an *electron* microscope.
- Although a bacterium is very small, it has all the *structures* necessary to carry out its *life* functions.

#### A. The structures of bacteria

1. Prokaryotic cells have *ribosomes*, but they are smaller than eukaryotes.
2. They have *genes* that are located for the most part in a single *circular* chromosome.
3. The cell *wall* protects the bacterium by preventing it from *bursting*. Bacteria live mainly in *hypotonic* environments.

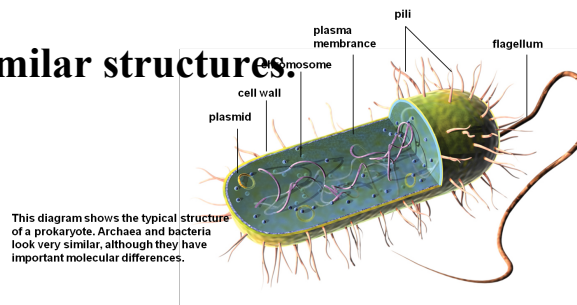
- Some virulent bacteria contain a structure called a ***capsule***, a ***gelatinous outer coating***, which gives the bacteria added protection from eukaryotic cells trying to engulf them, **i.e. white blood cells**.

### B. Differences between Bacteria & Archae include:

- Composition of ***cell walls & lipids of plasma membrane***
- Archea genes** more ***similar to*** eukaryotes in structure & function.

### C. Bacteria and Archaea have similar structures.

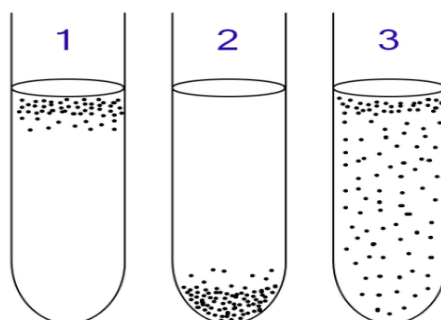
- plasmid***
- flagellum***
- pili***



## III. Adaptations in bacteria

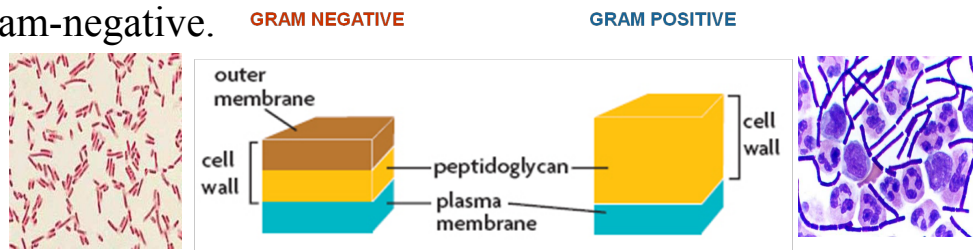
### A. Diversity of metabolism

- Many bacteria require ***oxygen*** for respiration. These bacteria are called ***obligate aerobes***.  
EX: *Mycobacterium tuberculosis* - causes Tuberculosis
- Obligate anaerobic** are bacteria that are ***killed*** by oxygen.  
EX: *Treponema pallidum* causes syphilis
- Some bacteria can live with or without ***oxygen*** called ***facultative aerobes***.

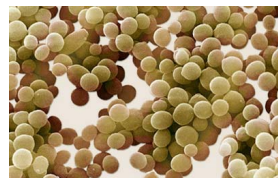


## B. Cell Wall Structure

1. Bacteria cell *walls* contain **peptidoglycan**
2. The amount of *peptidoglycan* within the cell wall can differ between bacteria
3. **Gram staining** is a technique that distinguishes two groups of bacteria because the stain reflects a basic *difference* in the *composition* of bacterial cell *walls*.
  - a. Gram-*negative* turns *pink - more* peptidoglycan
  - b. Gram-*positive* turns *purple - less* peptidoglycan
  - c. Gram-positive is affected more by *antibiotics* than gram-negative.



4. Bacteria have *three* common shapes
  - a. sphere shaped called *coccus* (pl. - cocci)



- b. rod shaped called *bacillus* (pl. - bacilli)

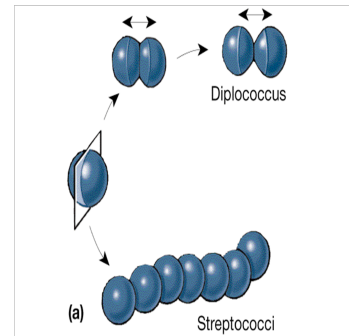
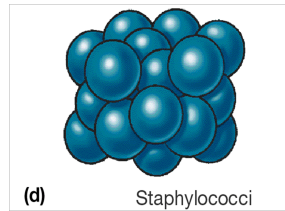


- c. spiral shaped called *spirillum* (pl. - spirilli)

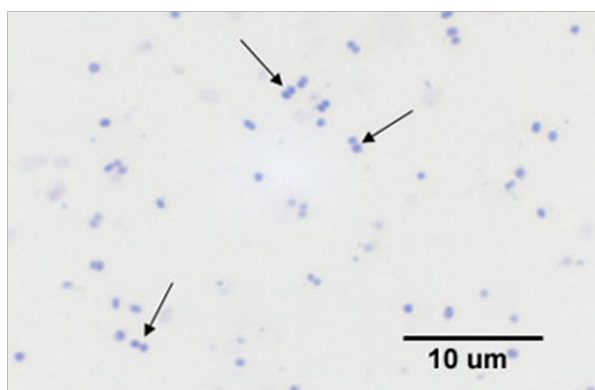
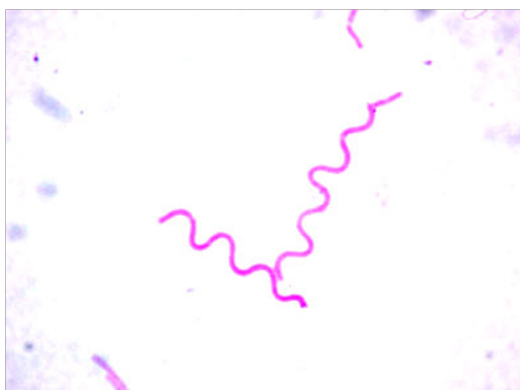
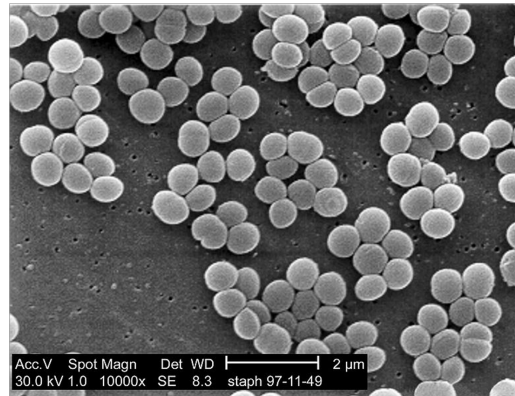
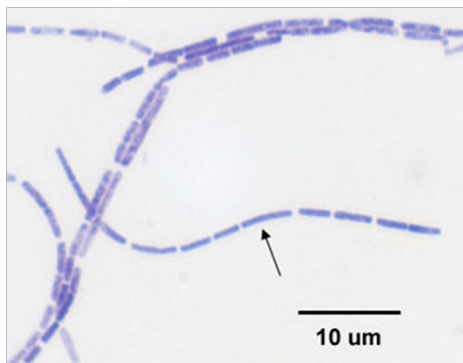


5. They also grow in patterns described in prefixes.

- a. Diplo - *paired* arrangement of cell growth.
- b. Staphlo - *clumped*, describes an arrangement of cells that resemble grapes.
- c. Strepto - *chained* arrangement of cells.



What would you call this?

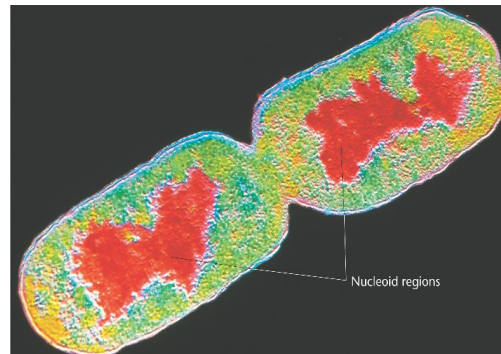




## C. Reproduction in Prokaryotes

### 1. Asexual

- Bacteria cannot reproduce by *mitosis* or *meiosis* because they have **no nucleus** and instead of chromosome pairs they have **one** circular chromosome, in a region called the **nucleoid**.
- Bacteria reproduce **asexually** by a process known as **binary fission**.
- After binary fission there are **two** cells that are genetically **identical**.



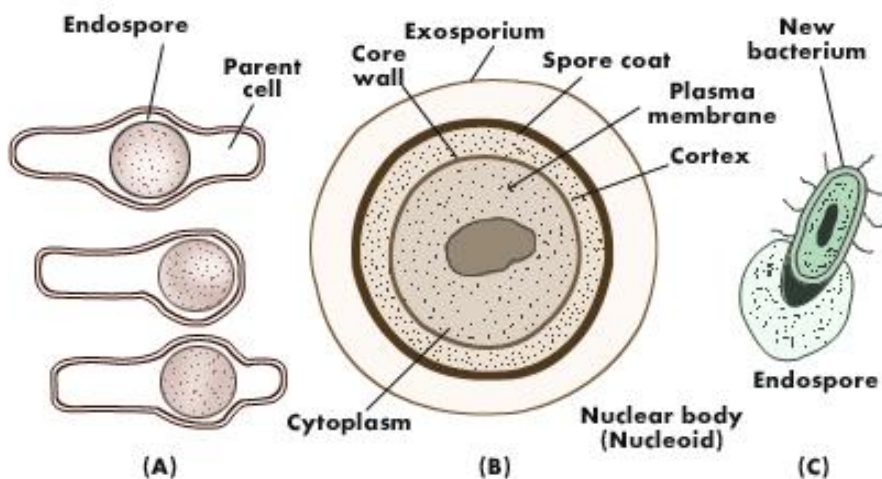
### 2. Sexual

- In addition to **binary fission**, some bacteria have a form of **sexual** reproduction called **conjugation**.
- This happens when one bacterium **transfers** all or part of its chromosome to another cell through a **pilus (pl. pili)**.
- Conjugation results in a bacterium with a **new genetic composition**.



### D. A survival mechanism

1. **Endospore** = a tiny structure that contains a bacterium's **DNA** and a small amount of its **cytoplasm**, encased by a tough **outer** covering.
2. When conditions are right the endospore **germinates** or produces a **cell** that begins to grow.
3. Endospores can cause problems for **humans**.
4. To **kill** endospores items must be **sterilized**.



Endospore formation. A, Endospores according to their position in parent cells. B, An endospore in cross-section. C, Germination of endospore