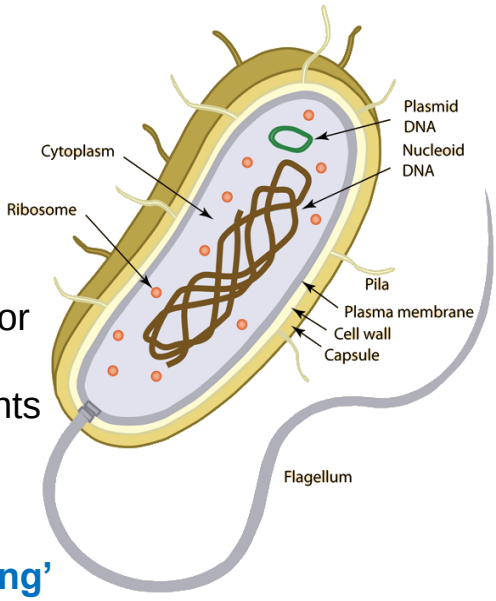
PROKARYOTES

- Prokaryotes are divided into 2 Domains: Archaea & Bacteria
- are the most numerous organisms on Earth. There are more bacteria on or in your body than there are people in the world!
- Members of these domains are extremely similar, differing only in **molecular structure**

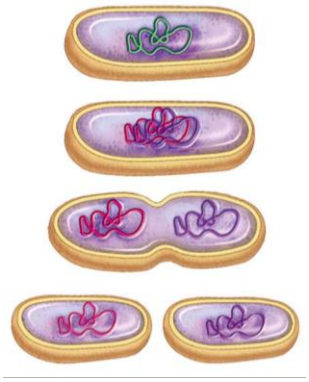


- **General Characteristics & Structure:**
  1. are **prokaryotic** = lack a nuclear membrane
  2. are **unicellular**, existing singly or in colonies
  3. lack a **cytoskeleton** and have few organelles
  4. have a single circular strand of **DNA (chromosome)**
  5. have a cell wall containing **peptidoglycan** (Bacteria) or **membrane lipids** (Archaea)
- Structures that help ensure survive in hostile environments
  - **capsule (slime layer)**
    : help evade immune systems & adhere to surfaces
  - **pili**
    : hair-like structures used for **anchorage** and '**docking**'
  - **endospore**
    : **protective coating** formed when conditions are unfavorable
  - **flagellum**
    : tail-like structure used for **movement**

**** since prokaryotes vary, not all features will be present in every cell**

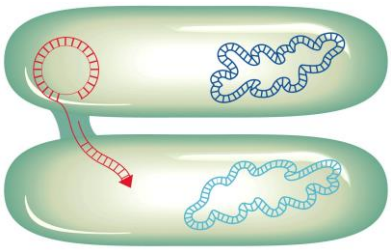
- **Reproduction**
  - as the simplest living organisms, prokaryotes can reproduce in a variety of ways

1. <u>Asexual Reproduction</u>
   - most common form of reproduction
   = **binary fission**
   :1 organism divides into 2, both genetically identical to the parent **(clones)**
   :can do this every 20 minutes if conditions of food and space are ideal
   = **warmth, moisture and prefer darkness**



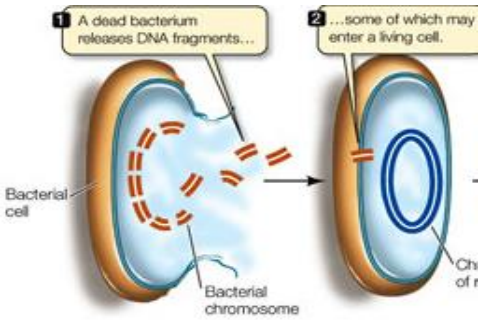
2. <u>Sexual Reproduction</u>
   - involves the union of two cells or parts of cells

   a) Conjugation
   : 2 cells line up side by side & **exchange** nuclear material before dividing
   = offspring have new genes **(and new traits)**



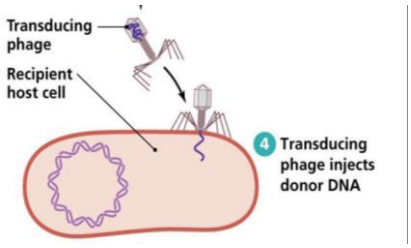
b) Transformation

: living bacteria **absorb & integrate** genes from dead bacteria into their own DNA
= gain new characteristics



c) Transduction

: a virus **attacks** a bacterial cell & **enters** it
: the bacterial cell incorporates the new gene the virus is carrying
: this method is used in biotechnology to create bacteria to produce valuable products (ie. insulin)



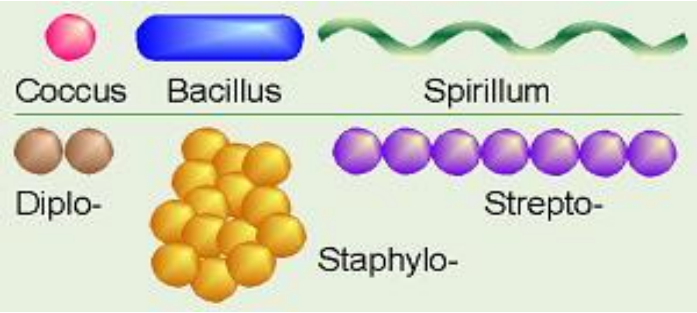
- **Classification**:
  - Currently identified using **DNA** but historically identified and named based on: Respiration, Nutrition, Shape and Arrangement

1. <u>Respiration</u>
   - prokaryotes can be grouped based on their need for oxygen
     a) **obligate anaerobes** = cannot live in the presence of O_2 **(poisoned by it)**
     b) **obligate aerobes** = need O_2 **(obligated to use it)**
     c) **facultative aerobes** = can live without O_2

2. <u>Nutrition</u>
   a) **Autotrophic** [create their own food]
     - <u>photosynthesizers</u> **=** use **sunlight** to convert $C0_2$ & H_20 to 0_2 & glucose
     - <u>chemosynthesizers</u> = change **inorganic materials** into organic materials

   b) **Heterotrophic** [ingest food via absorption]
     - <u>saprophytes</u> = feed on dead plant and animal matter **[decomposers]**
     - <u>parasites</u> **=** feed on living cells **[pathogenic organisms]**

3. <u>Shape and Arrangement</u>



Shape:
1. **Coccus** (plural cocci) - **spherical**
2. **Bacillus** (plural bacilli) - **rod-shaped**
3. **Spirillum** (plural spirilla) – **twisted / spiral**

Arrangement = use Prefixes
diplo = **two** eg. Dipplococcus
staphyl= **clusters** eg. Staphylococcus
strepto = **chains** eg. Streptococcus

- **Domain / Kingdom Bacteria**
  - most are **aerobic**
  - subdivided into many groups called **Divisions**
  - all can be classified as **Gram Positive** or **Gram Negative** based on whether it absorbs Gram's Dye
    : thicker peptidoglycan cell wall will absorb the Gram's Dye
    = determines which antibiotic to use against it
  - includes the Cyanophyta Division **(aka Blue-Green Algae)**
    : have chloroplasts containing chlorophyll & phycocyanin (blue pigment)
    : large numbers may cause 0_2 depletion = kill fish

- **Domain / Kingdom Archae**
  - thought to be more ancient than bacteria and yet more closely related to **eukaryotes**
    = have some of the same proteins
  - live environments similar to those when life first evolved on planet Earth
  - 3 different divisions (phyla):
    a) **Methanogens**
    - decompose sewage, garbage dumps, etc. producing methane gas
    = obligate anaerobes

    b) **Halophiles**
    = salt loving bacteria (the Dead Sea)
    - photosynthetic

    c) **Thermoacidophiles**
    = heat and acid loving bacteria (deep ocean volcanoes)
    - chemosynthetic

Benefits of Prokaryotes
-make **vitamins** in humans
- fix **nitrogen** for plants [Nitrogen cycle]
- produce **oxygen** and **food** [yogurt, cheese, vinegar]
- **recycle** dead things and wastes (bioremediation)
- **genetically engineered** to make drugs, antibiotics and hormones

Harmful Effects of Prokaryotes
-**de-nitrogen** fixing bacteria
- tooth decay
- cause **diseases** and **illness** in all organisms [ie. Tetanus, Food Poisoning]
- decomposers **[spoil food, etc]**
- damage crops