

BACTERIA

The Prokaryotes: Bacteria and Archaea

SBI3U Biology

[mythbusters - hidden nasties](#) (4:42)

[mythbusters - double dipping](#) (4:54)

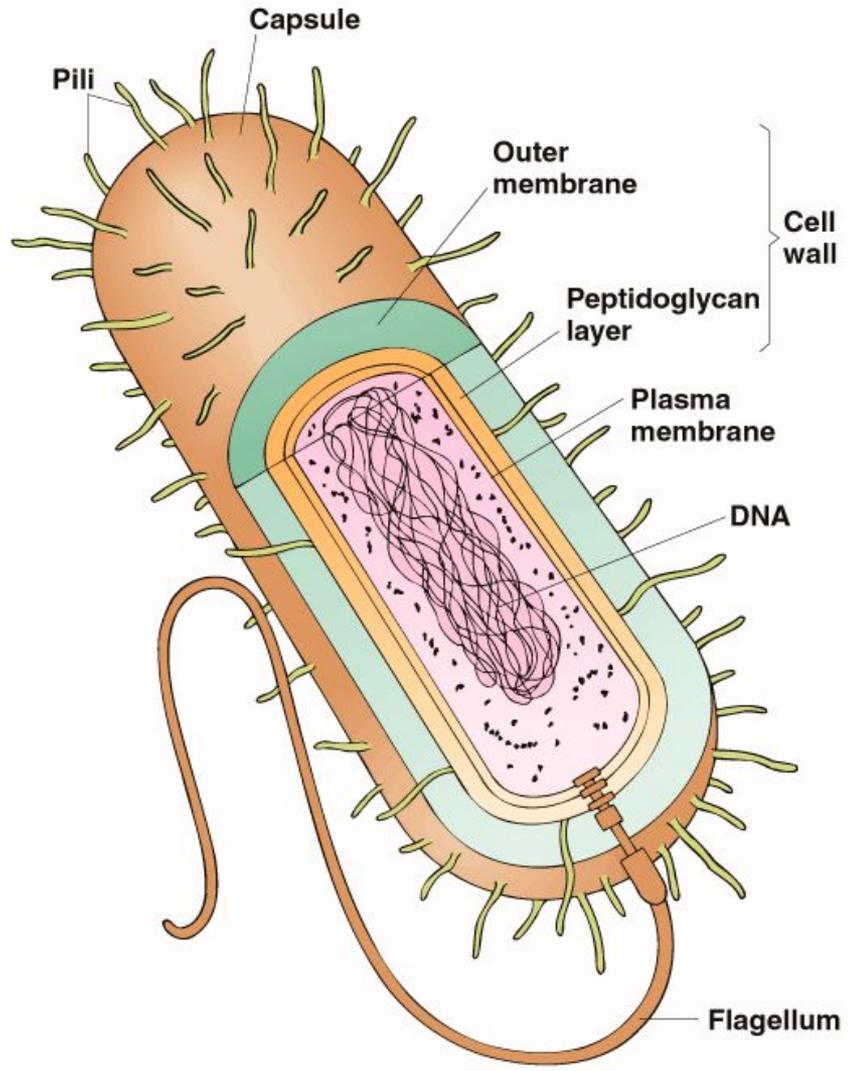
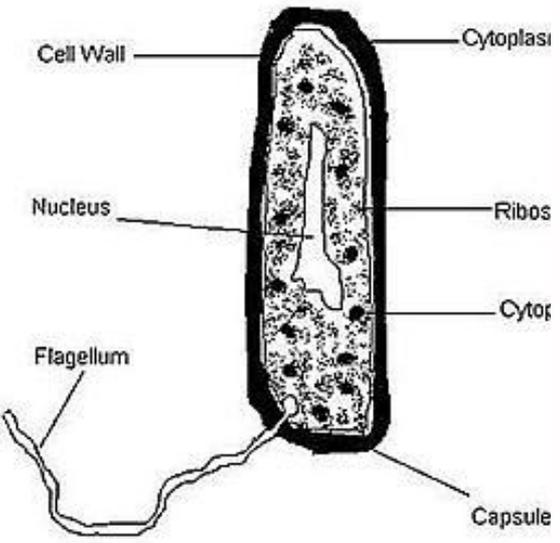
[Crash Course - Archaea, Bacteria, Protists](#)

[Khan Academy - Bacteria and Archaea](#)



Bacteria Cell

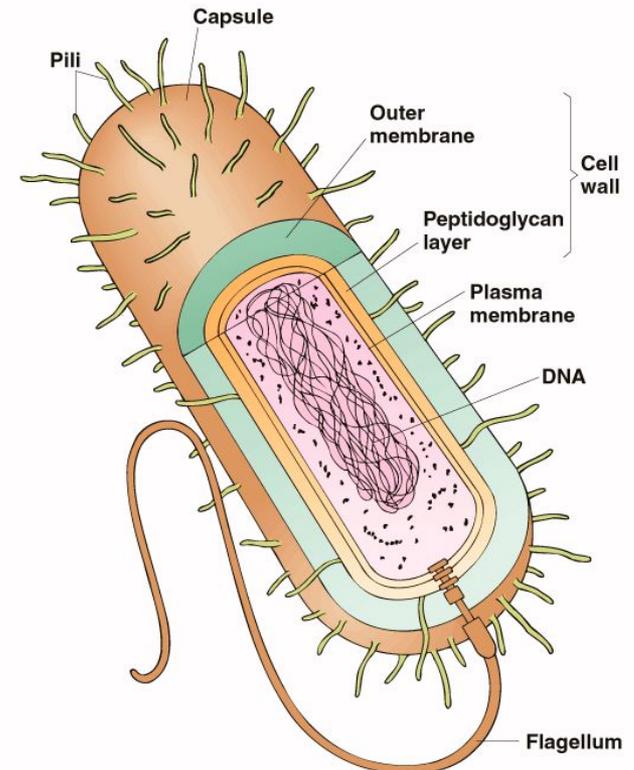
Typical Bacterial Cell



Characteristics of Bacteria

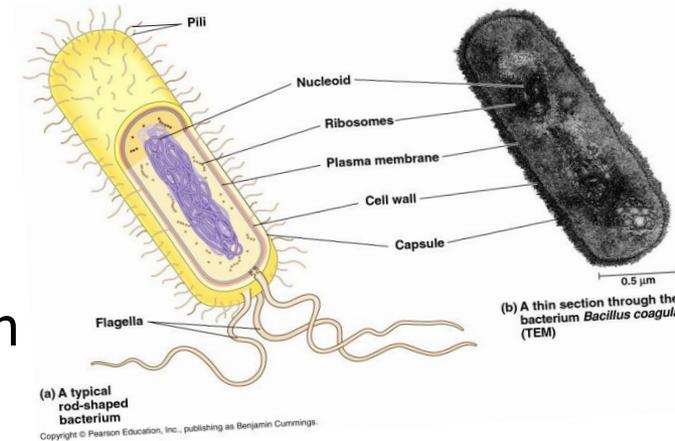
- Prokaryotic Cells
 - no nuclear membrane or other membranes around organelles
 - unicellular (single-celled)
 - small—less than 2 μm
 - only 1 circular chromosome

Solomon: Biology, 5/e
Figure 23.9



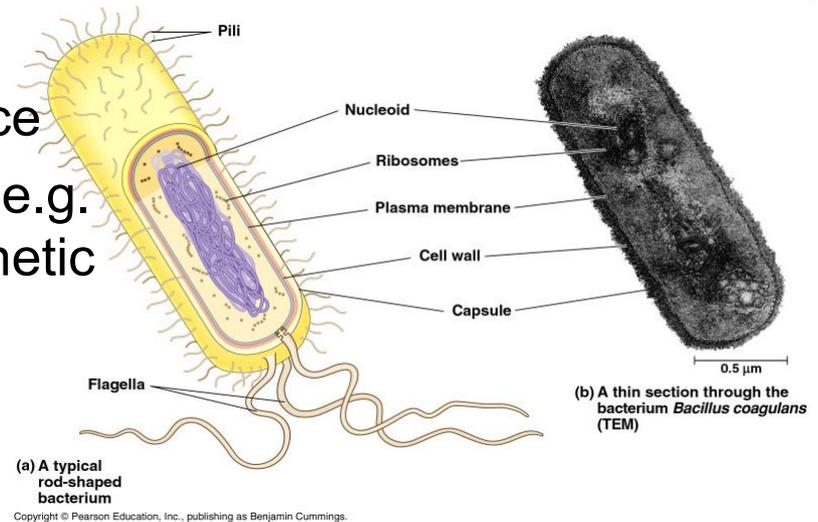
Important Structures:

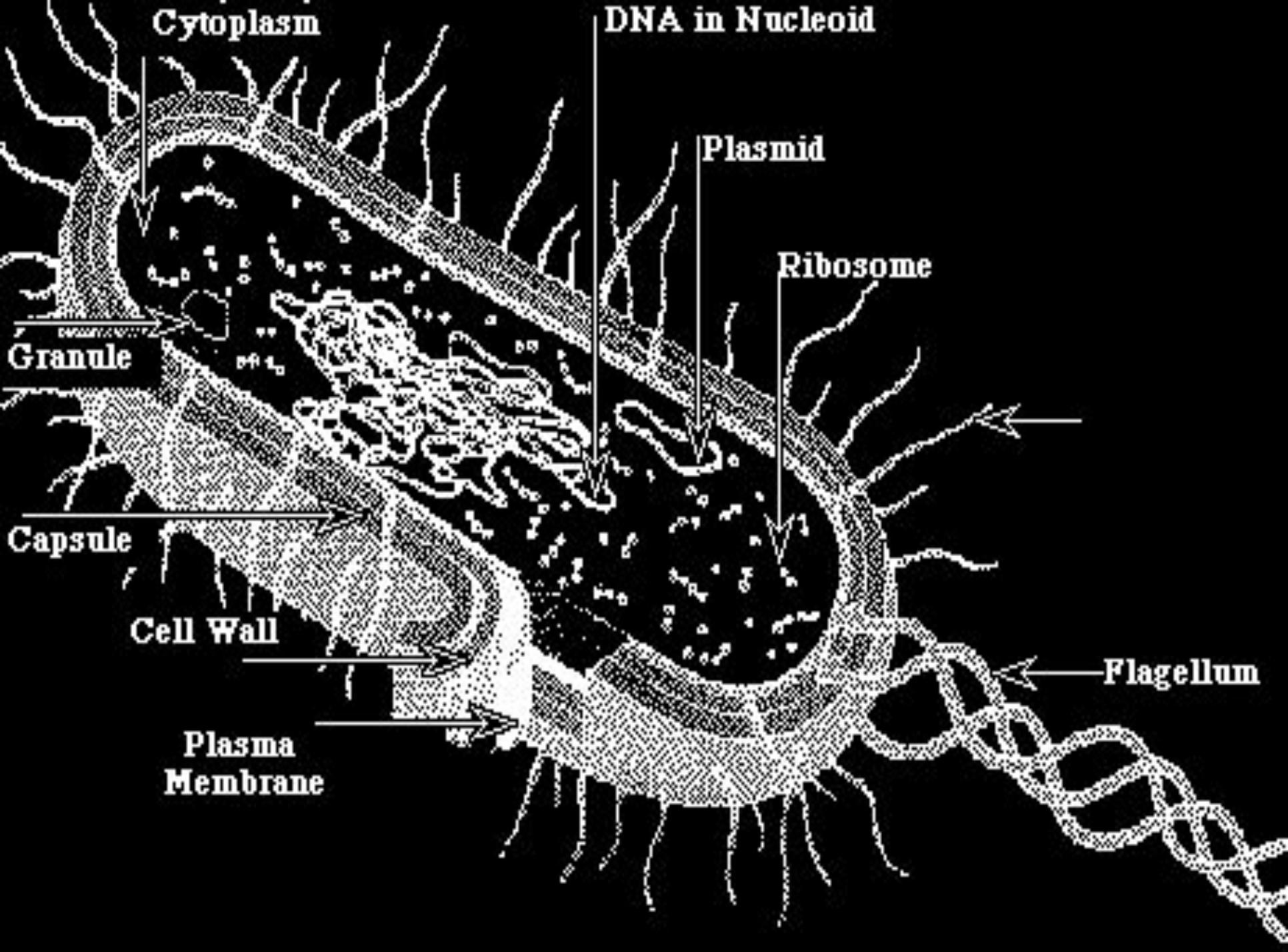
- Capsule - increases virulence (ability to cause disease)
 - allows bacteria to adhere to surfaces
 - protects it from being "eaten" by WBC
 - contains water to protect from dehydration
- Cell wall
 - made of peptidoglycan and outer membrane
 - provide rigidity, strength support and protection
- Plasma membrane - also called cell membrane
 - controls movement of substances in and out



Important Structures

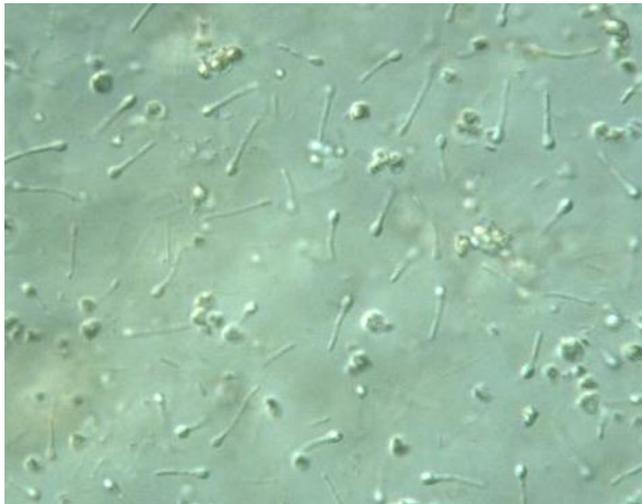
- Nucleoid region – Contains DNA, several proteins, & RNA
- Pili - hair like structure on bacteria surface
 - different pili have different functions (e.g. motility, attachment, exchange of genetic info.)
- Flagellum - whip-like structure
 - used for movement



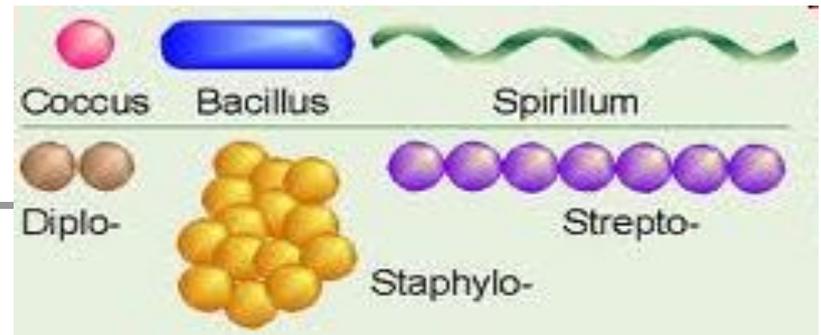


Identifying Prokaryotes

1. Cell Shape - spherical, spiral, rod
2. Cell Wall - gram + or gram - (structural differences)
3. Movement - snaking, propelling, gliding etc.



1. Bacterium Shapes And Groupings



SHAPES

- Coccus ~ Sphere shaped bacteria
- Bacillus ~ Rod shaped bacteria
- Spirillum ~ Spiral shaped bacteria

GROUPINGS

- Mono - one
- Diplo - two
- Strepto - in a chain
- Staphylo - cluster

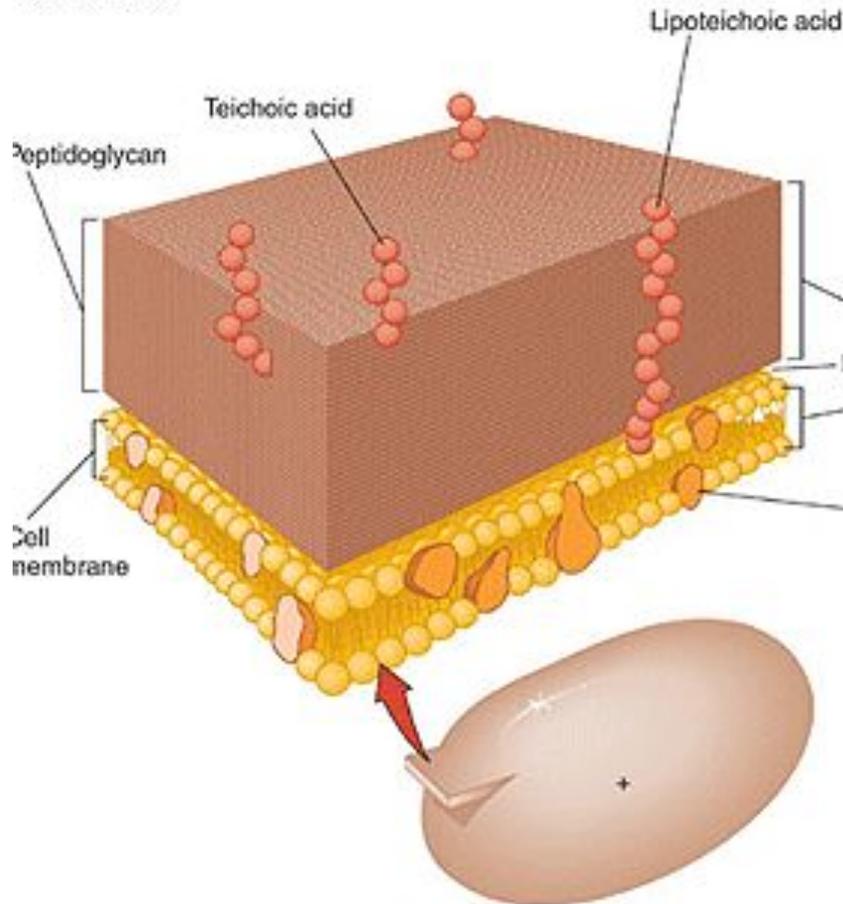
Draw/describe what you think the following look like:

- Streptobacilli
- Staphylococci

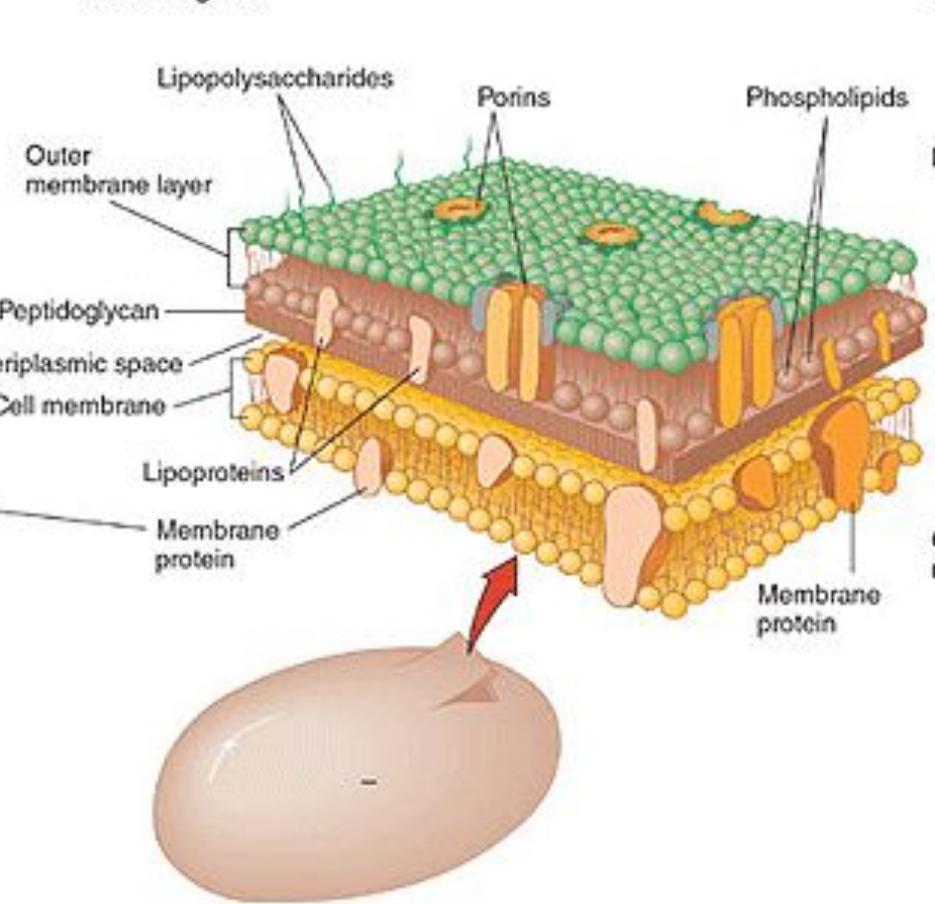
2. Gram + vs. Gram - walls

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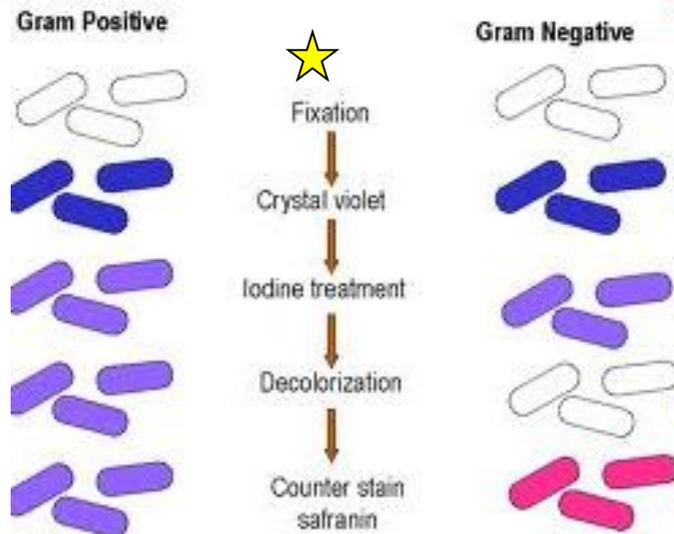
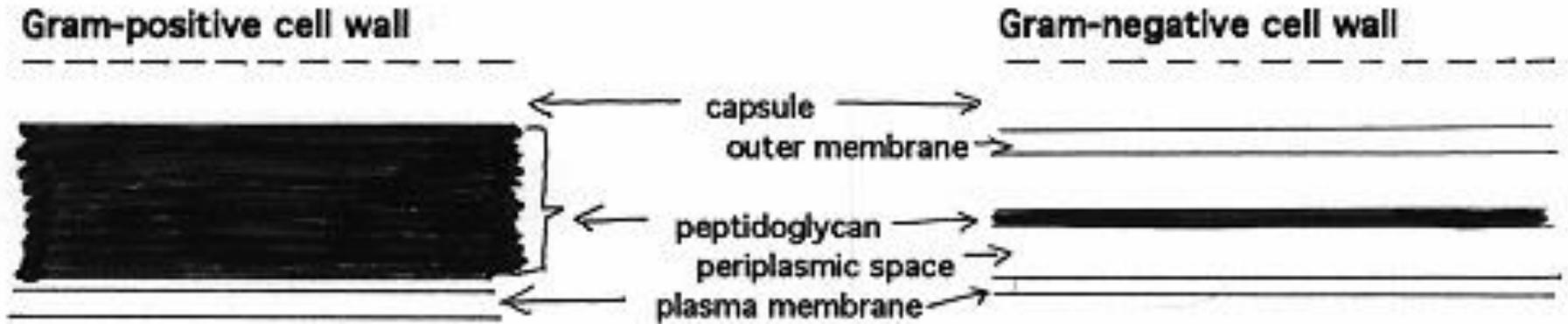
Gram Positive

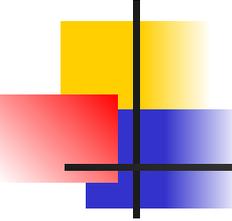


Gram Negative



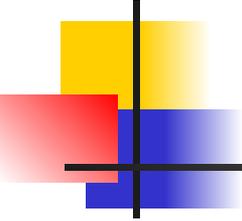
Bacterium Cell Walls: Gram + and Gram -





Gram + vs. Gram -

gram +	gram -
<ul style="list-style-type: none">● give + result in gram stain test	<ul style="list-style-type: none">● give - result in gram stain test
<ul style="list-style-type: none">● take up crystal violet stain	<ul style="list-style-type: none">● alcohol degrades cell wall allowing crystal violet stain to wash away
<ul style="list-style-type: none">● look purple under microscope	<ul style="list-style-type: none">● take up counter stain and appear pink
<ul style="list-style-type: none">● have thick peptidoglycan layer that retains the stain	<ul style="list-style-type: none">● thin peptidoglycan layer
<ul style="list-style-type: none">● more receptive to antibiotics	<ul style="list-style-type: none">● less receptive due to outer membrane



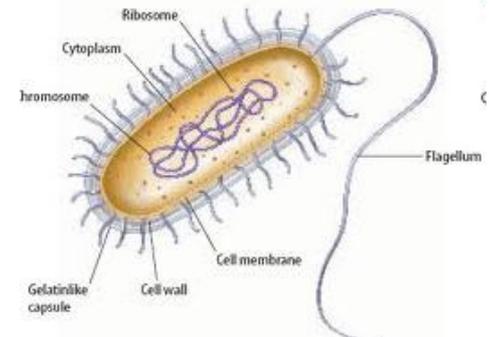
Cell Walls cont'd

- Chemical nature of a cell wall can be determined by Gram Staining.
- By finding out what colour the cell produces when it is gram stained you can figure out the type of carbohydrates in the cell wall.
- Why would this be helpful?

Classes of Antibiotics

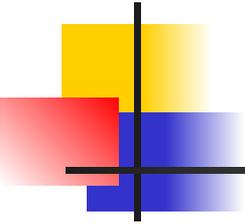
3. Movement

- **Flagellum** ~ Tail like structure that whips around to propel the bacterium
- **Cilia** ~ small hair-like projections surrounding the cell that help it to “swim”, moves back and forth in a synchronized movement
- **Non motile** ~ Sticky cilia like structures that keep the bacterium from moving

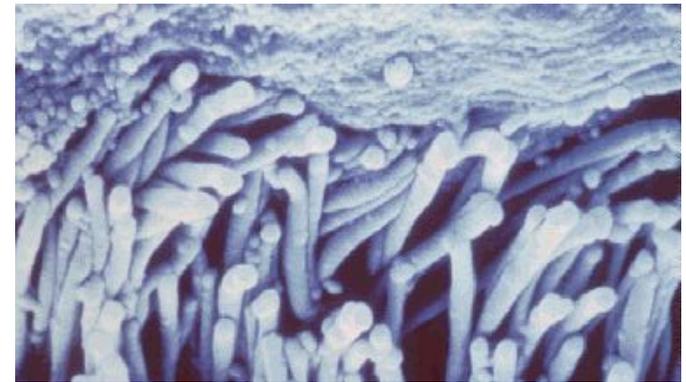
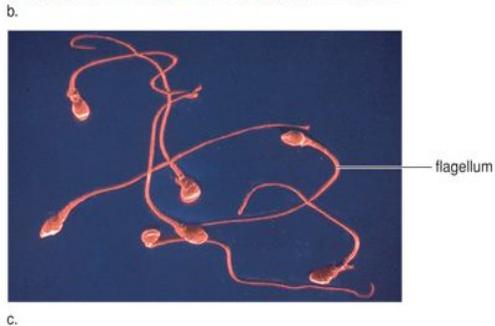
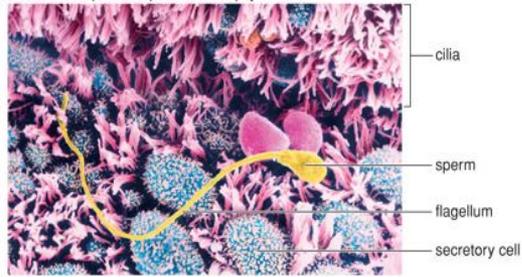
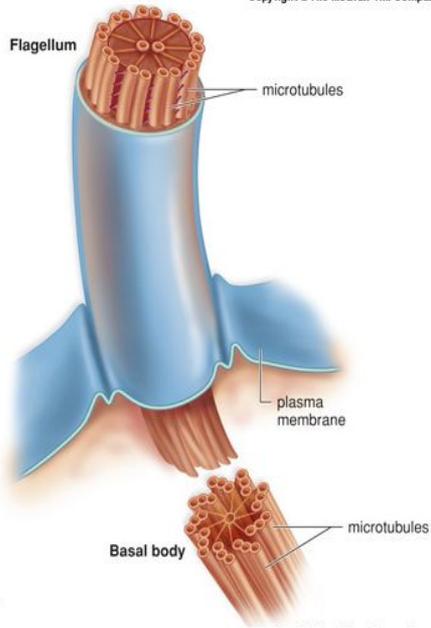


Flagella

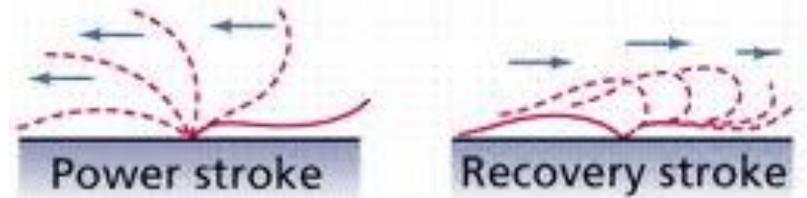
Cilia



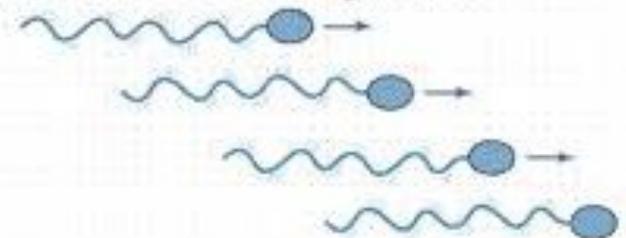
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Movement of cilium

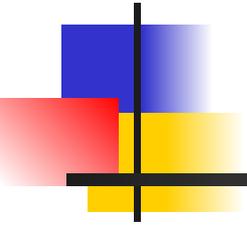


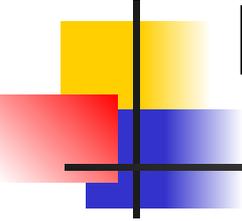
Movement of flagellum



b: © Y. Nikas/Photo Researchers, Inc.; c: © David M. Phillips/Photo Researchers, Inc.

OTHER TERMS USED TO CLASSIFY BACTERIA



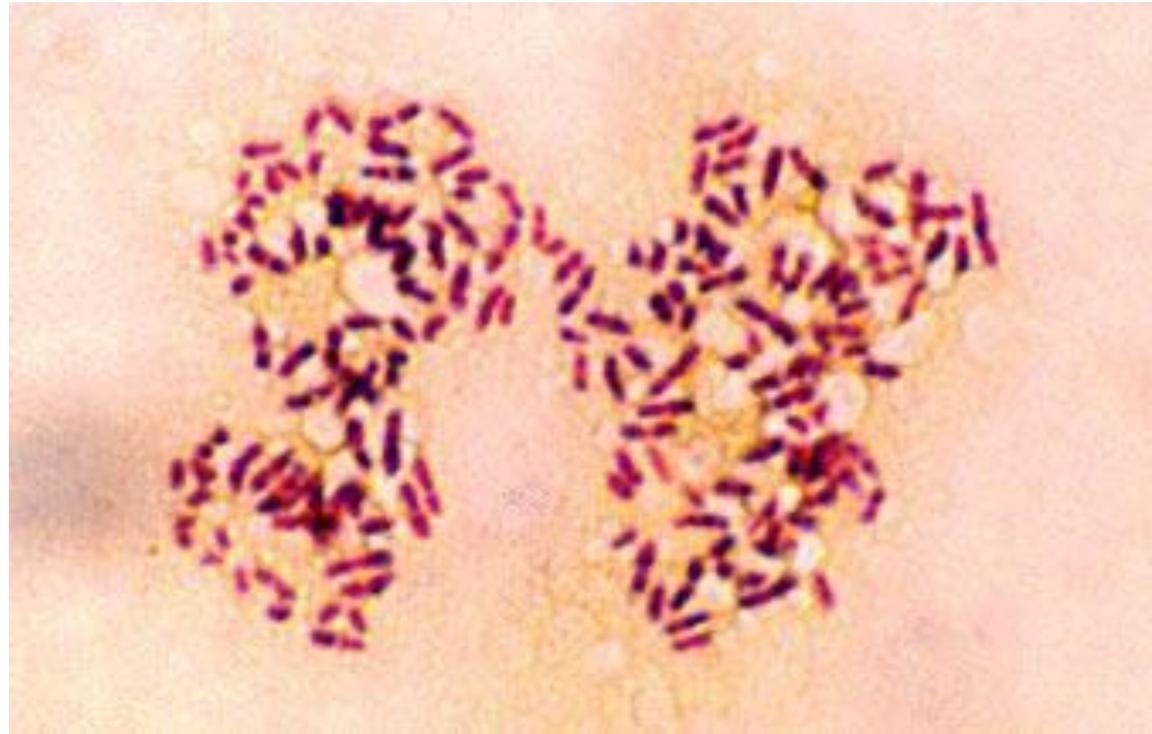


Bacterial Respiration

- Aerobic - grows in the presence of oxygen
- Anaerobic - grows in the absence of oxygen
- Obligate Aerobes - must have oxygen
- Obligate Anaerobes - must have NO oxygen
- Facultative Anaerobes - can grow with or without oxygen

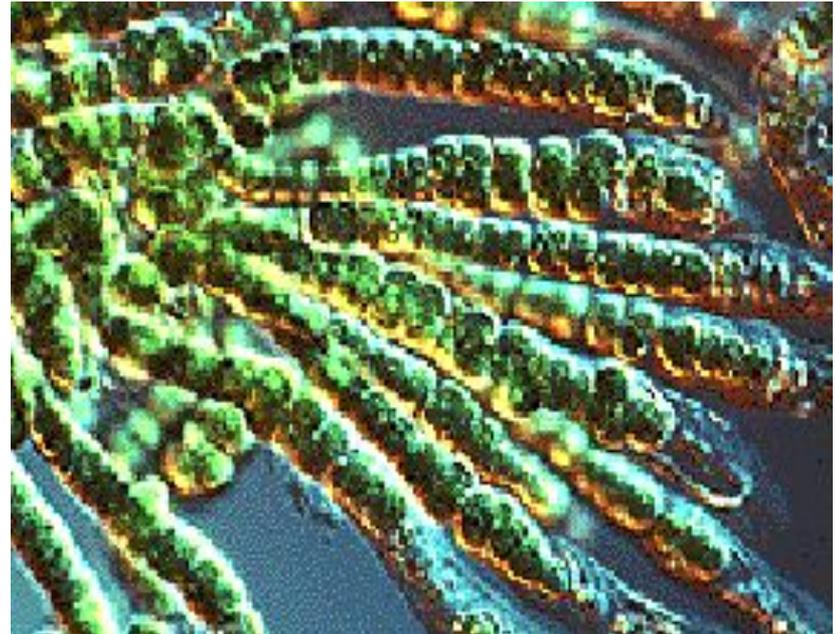
Bacteria and Metabolism

- Autotrophs
- Heterotrophs
- Chemotrophs



Autotrophs

- make their own energy
- use solar energy (or other chemical compounds) to 'fix' carbon dioxide
- eg. Cyanobacteria uses photosynthesis to make glucose



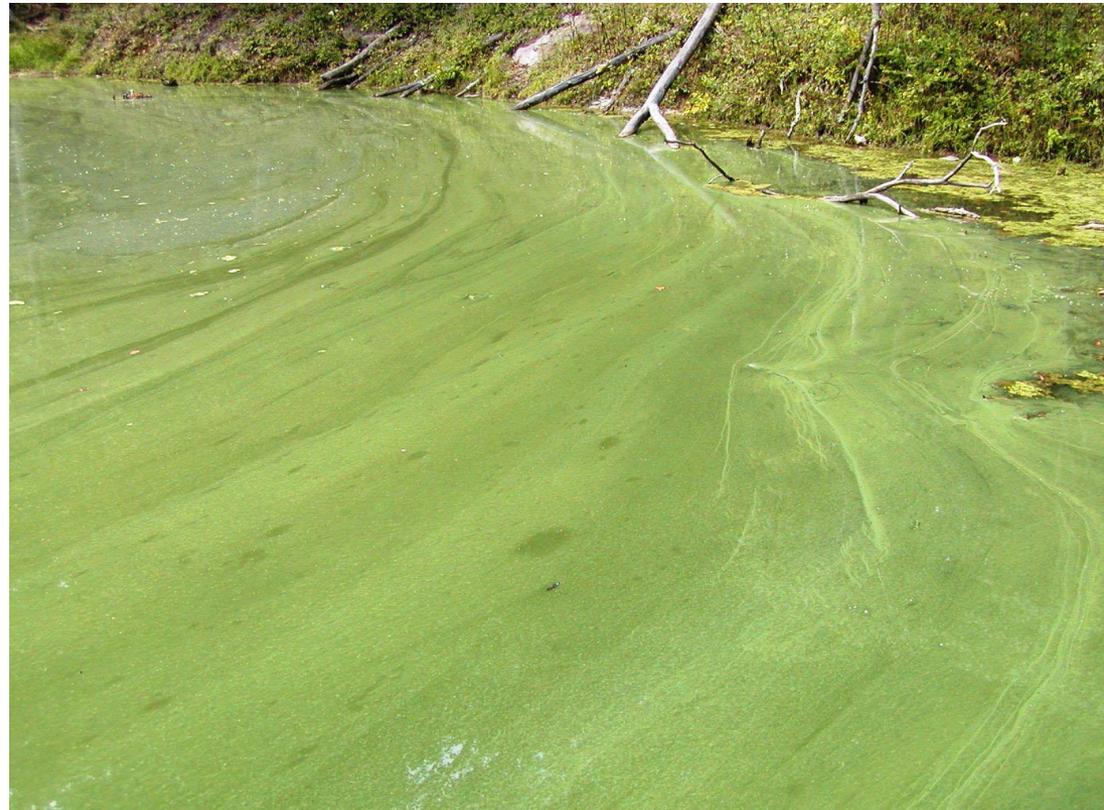
Example: Cyanobacteria

- Photosynthetic bacterium
- Bluish-greenish color
- Contain membranes that carry out the process of photosynthesis
- Do not contain the same type of chloroplasts as plants do
- This bluish-greenish algae can be found nearly everywhere on earth.
- Can survive in extremely hot environments and even extremely cold environments



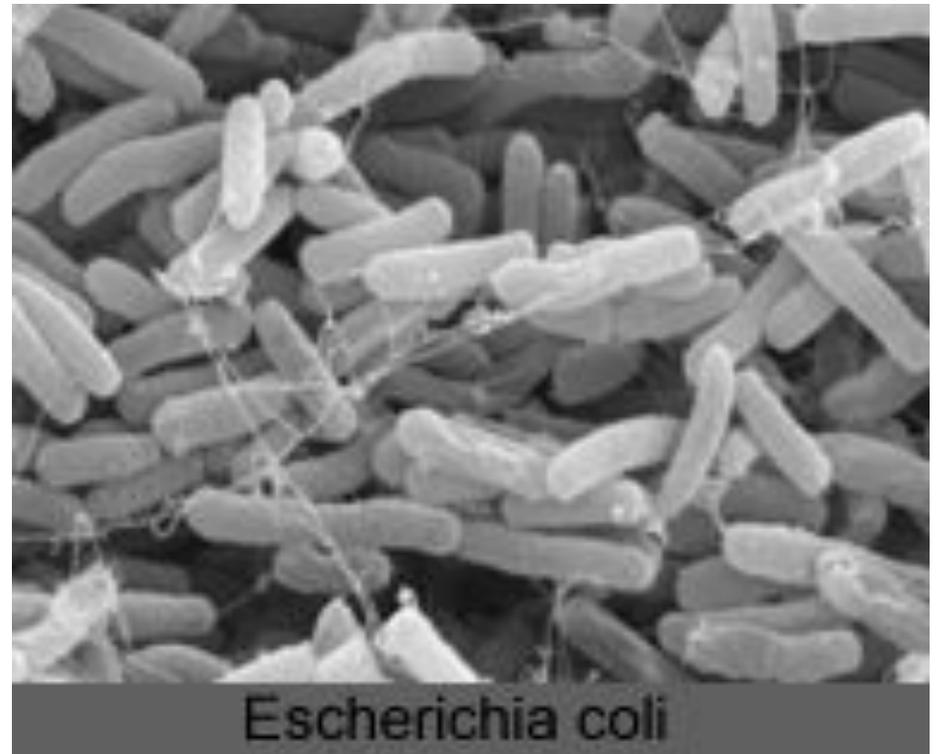
Why are Cyanobacteria not in the Plant Kingdom??

- Can exist unicellularly
- Prokaryotic (no nucleus and membrane-bound organelles)



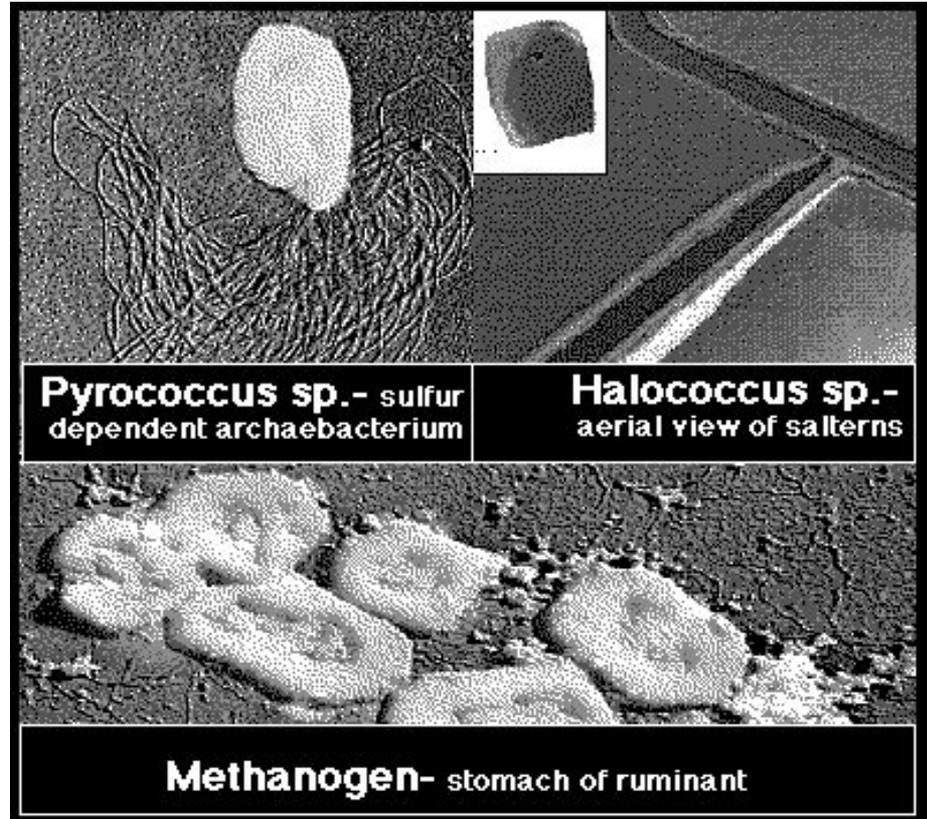
Heterotrophs

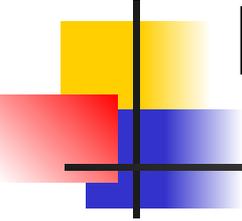
- Obtain energy from eating other organisms
- Eg. *E. coli*



Chemotrophs

- makes own energy from chemicals like sulfur or hydrogen sulfide
- Eg. Archaeobacteria living in the gut

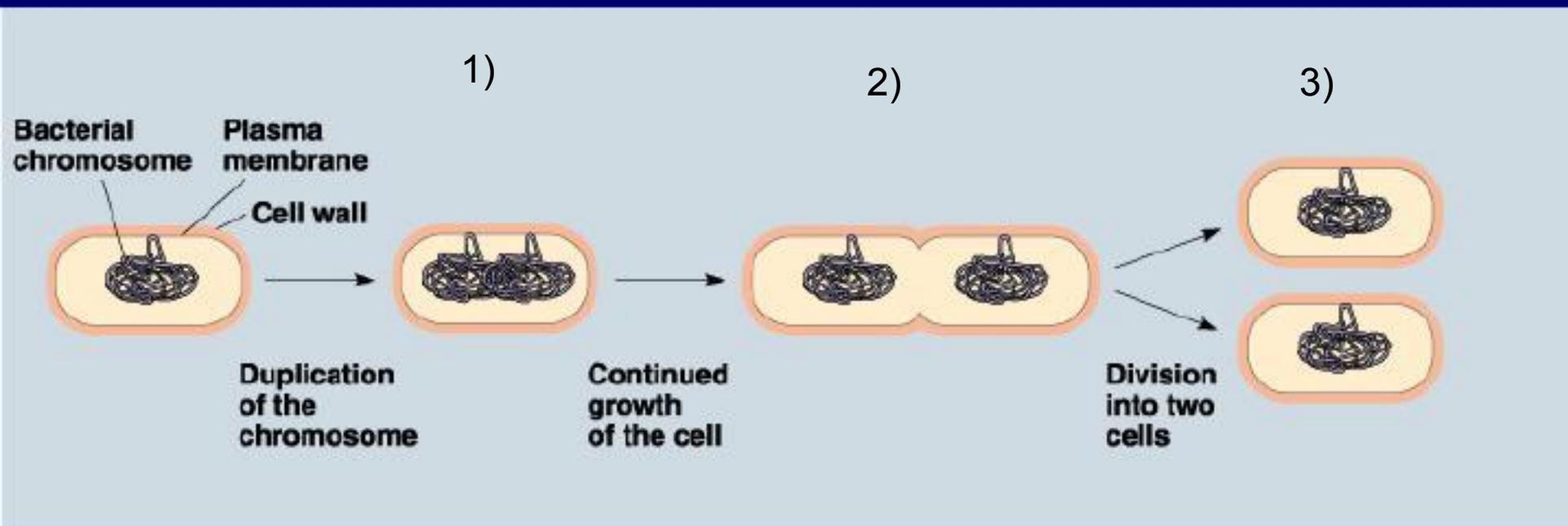




Bacterial Reproduction

1. Binary Fission (asexual)
2. Conjugation (sexual)
3. Spore Formation (dispersal of genetic information)

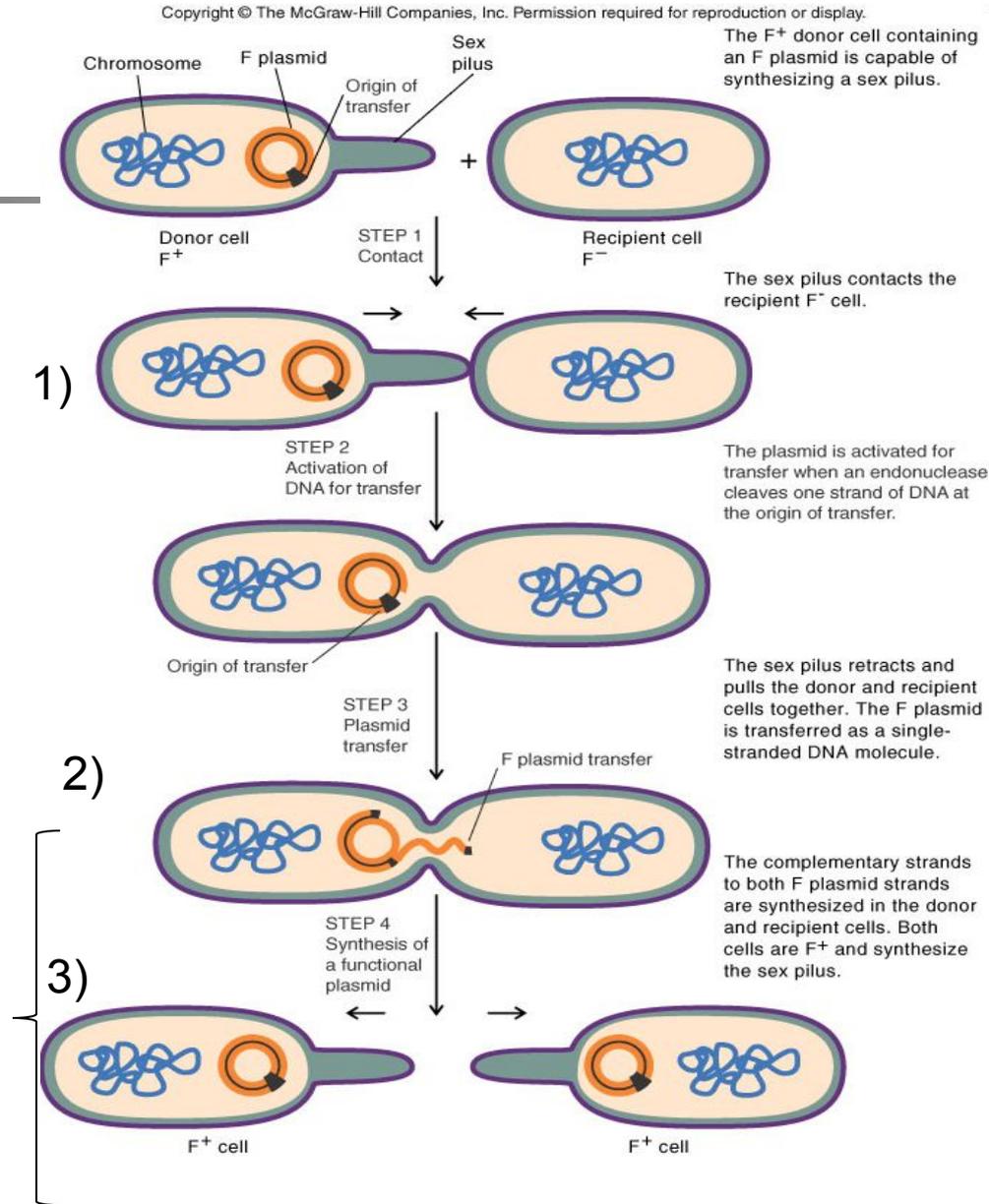
Binary Fission in Bacteria



Cellular organism copies its genetic information then splits into two identical daughter cells.

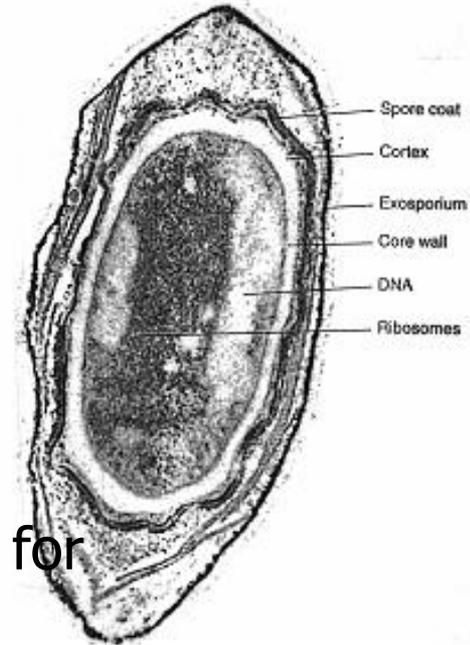
Conjugation

- Bacteria sex!
- 1 bacterial cell passes a copy of a plasmid through a hollow pilus
- For example, that contains the information such as a resistance to penicillin



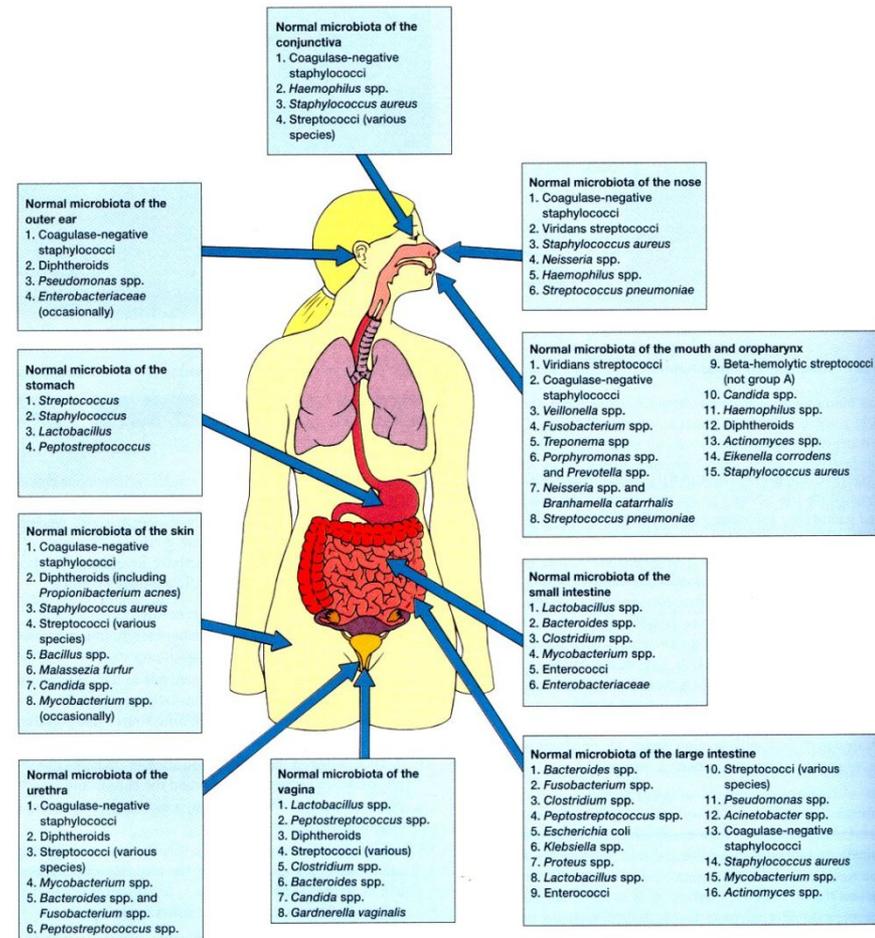
Spore Formation: Endospore

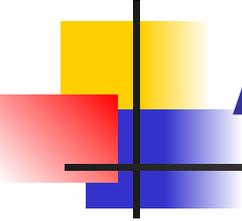
- Not a form of reproduction but a way to survive unfavourable conditions
- Highly resistant structure that forms around the chromosome when cell is under some sort of environmental stress such as:
 - -High temperatures
 - -Irradiation
 - -Strong acids
 - -Disinfectants
- Spores of tetanus and anthrax can survive in soil for many years



Symbiosis – Parasitism, Mutualisms, Commensalism

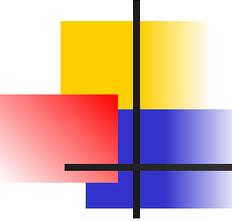
- Close relationship between two species in which at least one species benefits from the other
- Live together for LIFE
- Human bodies contain many types of bacteria inhabiting different organ systems. Some of these bacteria, particularly those of our intestine and skin, enhance our digestion and immune system.





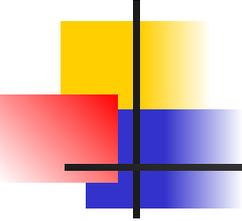
Archaea

- Prokaryotic
- Don't look that different from bacteria under a microscope
- VERY different biochemically and genetically
- Include inhabitants of the most **extreme** environments on Earth



Other Archaea Terms

- **Chemotrophs/Methanogens** – convert chemical compounds into methane gas
- **Halophiles** – like salt water (oceans)
- **Extreme Thermophiles** – like warm environments (hot springs)
- **Psychrophiles** – cold-loving organisms (Arctic soil)



Archaea - A summary

- Lack important carbohydrate found in cell walls (Gram -)
- Have different lipids in their cell membrane
- Different types of ribosomes
- Very different gene sequences
- Do not cause disease
- Archaea live in extremely harsh environments
- They do not require oxygen (anaerobic) and can live in extremely salty (halophiles) environments, as well as extremely hot (thermophiles) or cold (psychrophiles) environments.

Bacteria - A summary

- Make up the larger of the two prokaryote kingdoms
- Generally are surrounded by a cell wall composed of complex carbohydrates
- Gram + and –
- Can cause disease
- Live nearly everywhere

