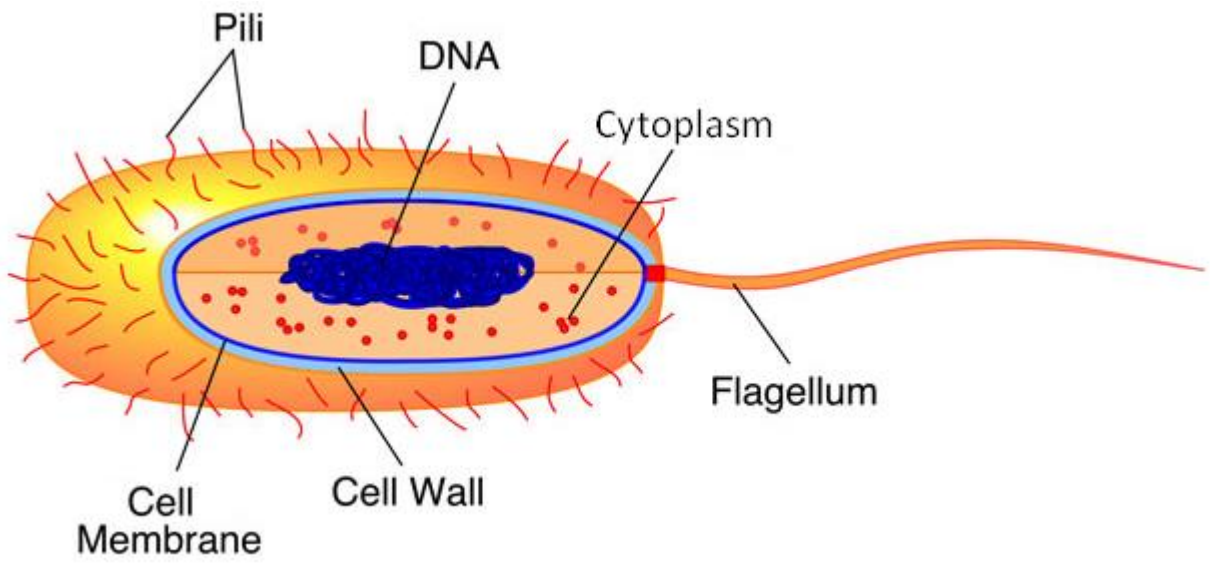
MICROBIOLOGY
CHAPTER 3
Bacteria Morphology

3:1 Bacteria – Structure and Function

MORPHOLOGY: the study of form and structure



Structure of Bacteria

1. PROKARYOTIC – no membrane bound nucleus nor other organelles
2. APPENDAGES – flagella and pili
3. SURFACE LAYERS – capsule, cell wall, cell (cytoplasmic) membrane, mesosome
4. CYTOPLASM – nuclear material, plasmids, ribosomes, inclusions, chromatophore
5. SPECIAL STRUCTURES

3:2 Appendages

MOTILITY: the ability of an organism to move by itself

SPIRILLA → MOTILE

BACILLI → MOTILE, NON-MOTILE

COCCI → NON-MOTILE

FLAGELLA: long, slender, thread like appendages used as propulsive mechanism in bacteria

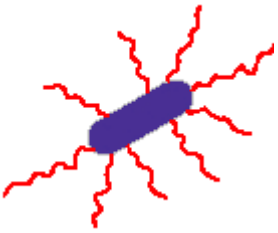
Flagella are too small to be seen with a light microscope.

Bacterial Flagella Styles

1. MONOTRICHOUS: one flagellum on one end

2. LOPHOTRICHOUS: cluster of flagella on one end

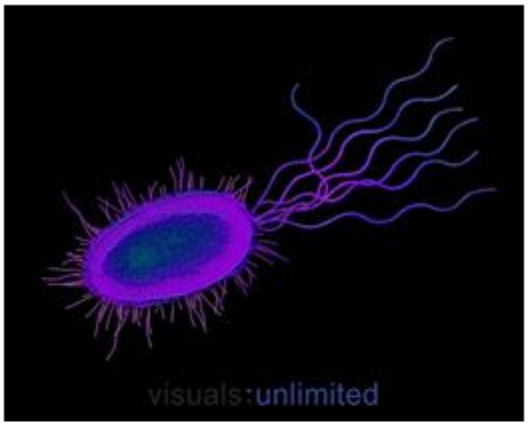
3. PERITRICHOUS: surrounded by flagella on all sides



4. AMPHITRICHOUS: flagella on both ends of the cell, either cluster or single

Label these flagella styles:

1)



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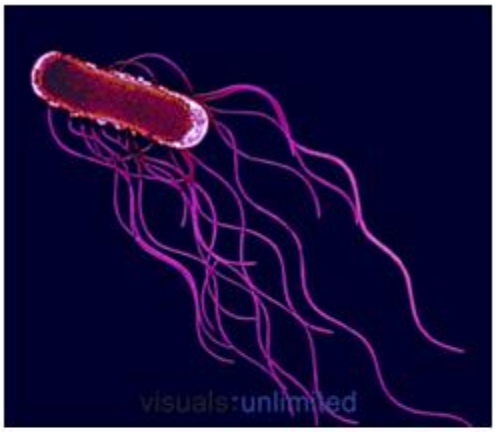

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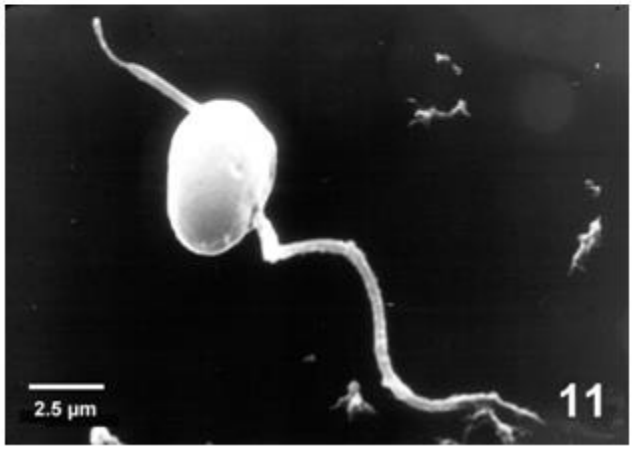
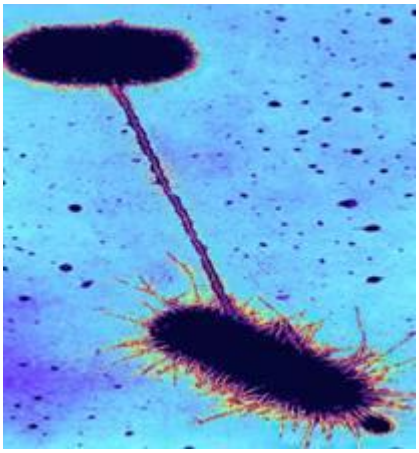


4)

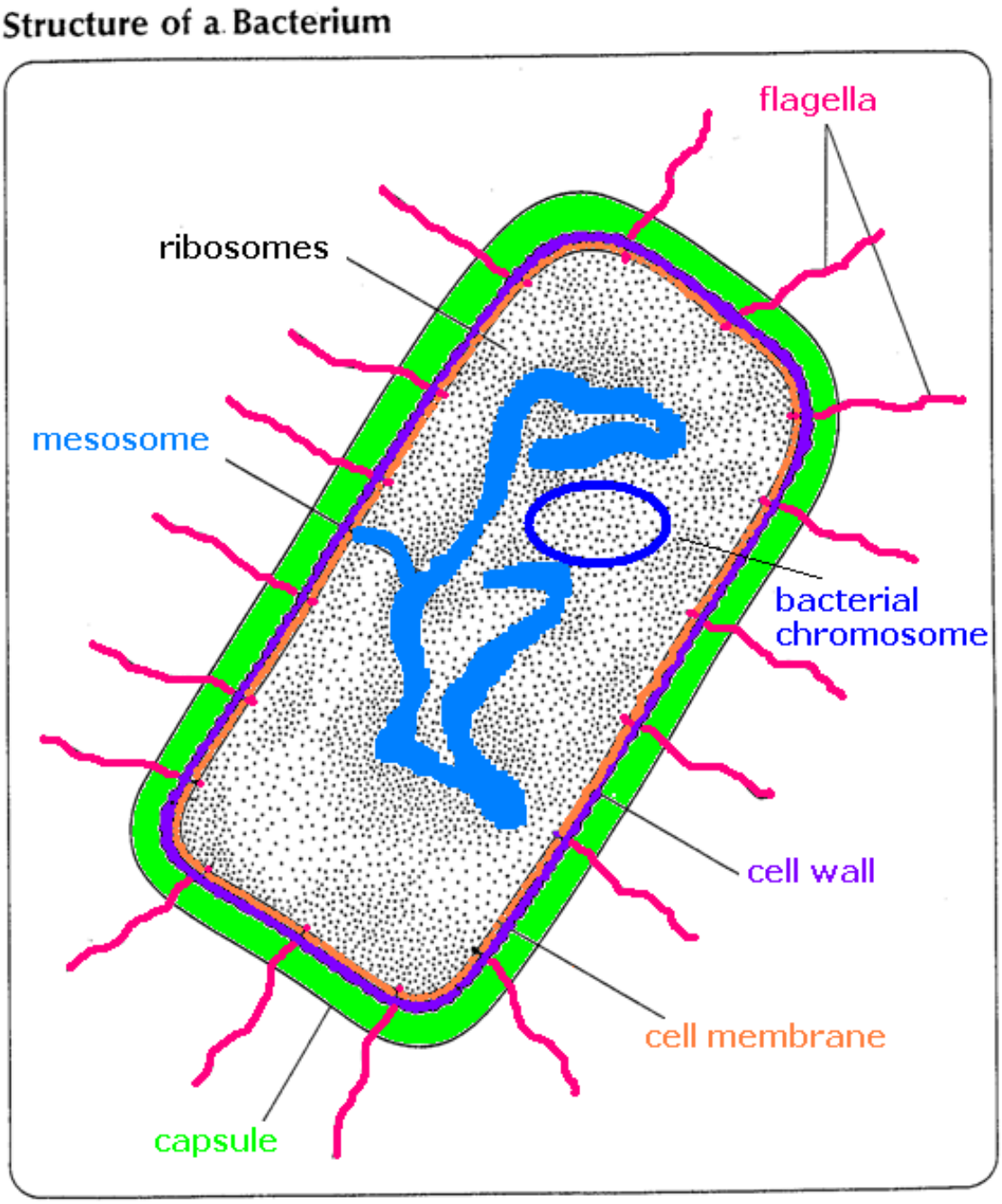
Bacterial flagella spin by means of a rotating joint.

- If flagella spins counterclockwise – bacteria move in a straight line
- Clockwise – bacteria will tumble aimlessly

<u>PILI</u>: short small appendages involved in DNA transfer during conjugation



3:3 Surface Layers



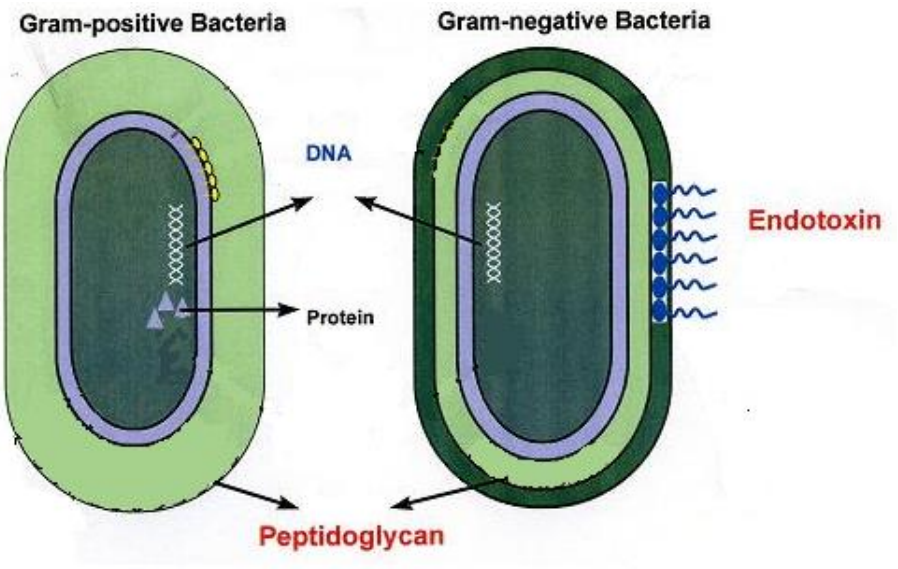
<u>CAPSULE</u>: external layer of thickened adhesive material that allows bacteria to stick to surfaces

- Removing capsule from disease-causing bacteria will render them harmless
- Capsule protects bacteria against desiccation and ingestion by host's phagocytes (white blood cells)

CELL WALL: layer of peptidoglycan that supports the bacterial cell and gives it its shape

Drugs that attack the cell wall will kill bacteria without harming host since animals lack cell walls.

Differences in cell walls are responsible for (+) and (-) Gram stain reactions.



Gram positive cell walls

1. Thick (20—80 nm)
2. 60 to 80% peptidoglycan
3. Do not contain protein

Gram negative cell walls

1. Thinner than Gram (+)
2. 10-20% peptidoglycan
3. Contain ENDOTOXIN: sugar secreted by bacterial cell wall that is highly toxic to animals and is responsible for high fevers in Gram (-) infections

CYTOPLASMIC MEMBRANE: membrane located inside the cell wall that regulates the passage of materials between the bacteria and the environment

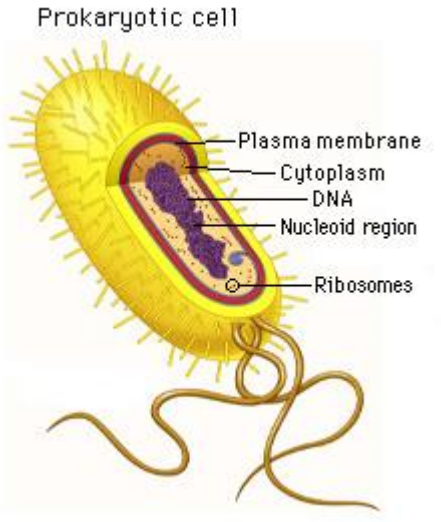
MESOSOME: invagination of the cytoplasmic membrane

Functions of the Mesosome

1. Hold the “naked” DNA in place
2. Important to cell wall synthesis
3. Aids in division of nuclear material during cell division

3:4 Cytoplasm

CYTOPLASM: cell material contained within the cell (cytoplasmic) membrane



Cytoplasm contains:

- 80% water
- nucleic acids
- proteins
- carbohydrate, lipids
- inorganic ions

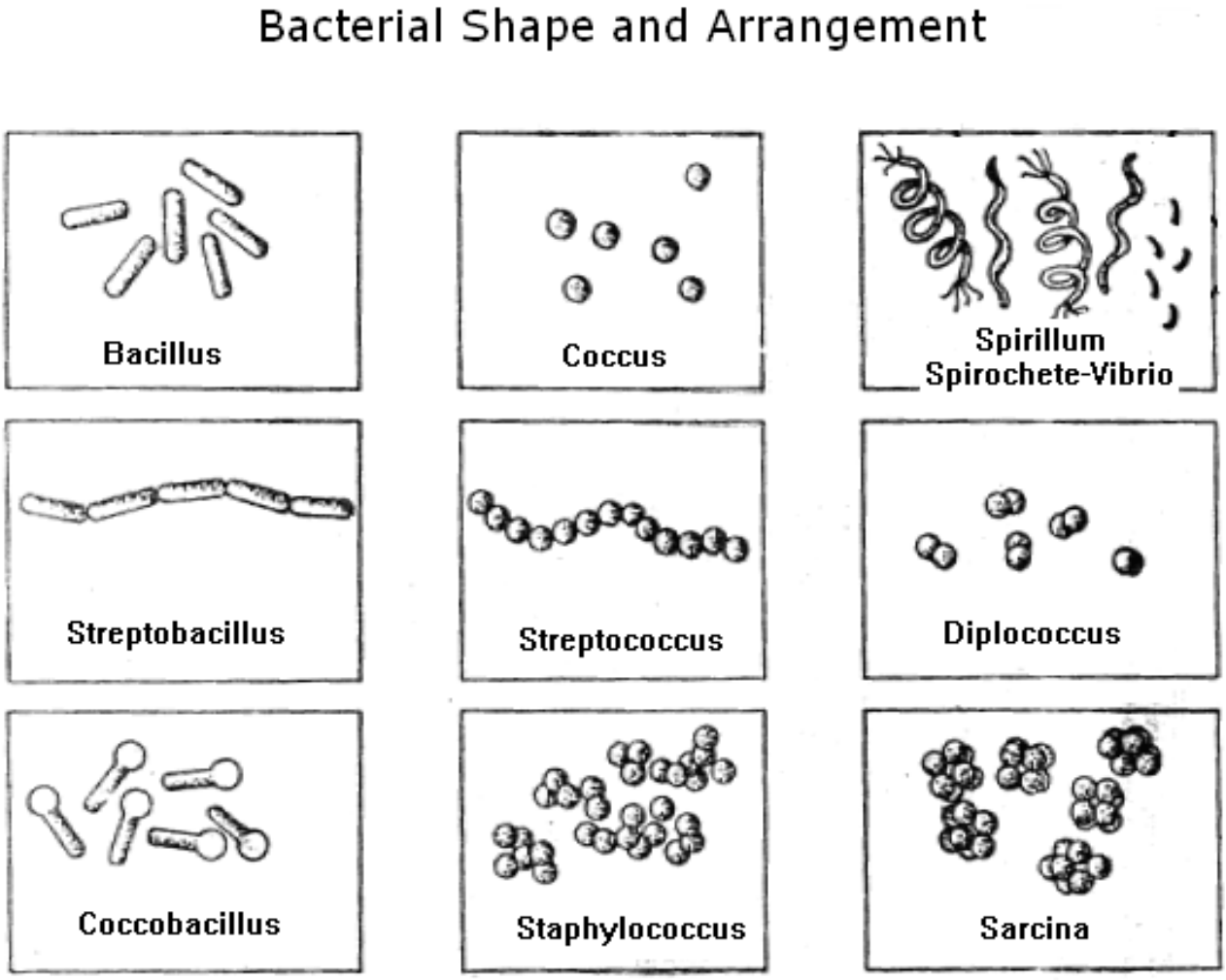
BACTERIAL CHROMOSOME: single circular molecule of double stranded DNA not bounded by a membrane, found near the center of the cell attached to the mesosome-cell membrane system

RIBOSOMES: RNA-protein particles that are the site of protein synthesis

INCLUSION BODIES: globular storage areas in the cytoplasm where different types of chemical substances accumulate

CHROMATOPHORE: vesicles that contain photosynthetic pigments in prokaryotic cells

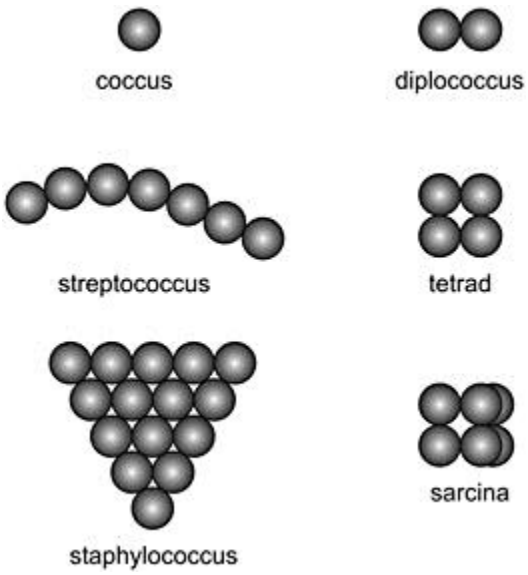
3:5 Bacterial Shape



<u>COCCI</u>: spherical or ellipsoidal bacterial cells

<u>Arrangement of Cocci</u>

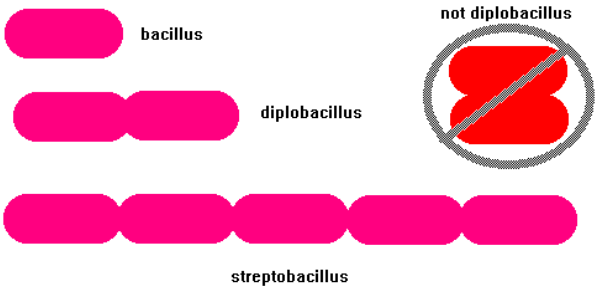
1. <u>DIPLOCOCCI</u>: pairs of spheres
2. <u>TETRACOCCI</u>: groups of 4 spheres
3. <u>STREPTOCOCCI</u>: chains of spheres
4. <u>STAPHYLOCOCCI</u>: clusters of spheres
5. <u>SARCINAE</u>: spheres in a cubical arrangement



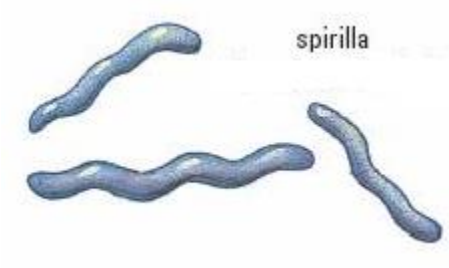
BACILLI: cylindrical or rod shaped bacterial cells

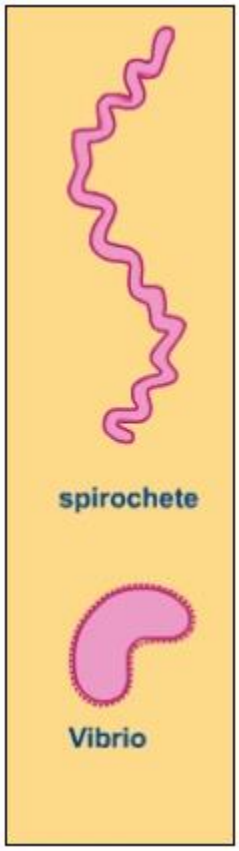
Arrangement of Bacilli

1. DIPLOBACILLI: pairs of rods
2. STREPTOBACILLI: chains of rods



SPIRILLA: spiral bacterial cells





Types of Spirilla

1. SPIROCHETES: spiral cells responsible for serious human disease

2. VIBRIOS: short incomplete spiral or comma bacteria

3:6 Endospores

ENDOSPORES: small thick-walled highly resistant bacterial cell capable of producing a vegetative (growing) cell.

Cells form spores to resist high temperatures, desiccation, and chemical agents like disinfectants.

Formation of Endospore

1. FORESPORE forms → DNA aligns at one end of cell, cell membrane invaginates
2. SPORE CORTEX and SPORE COAT develop → layers cover forespore
3. Cell undergoes LYSIS → breaks open to release endospore

Bacillus and Clostridium form endospores that cause diseases such as tetanus, botulism, and gas gangrene.