

Prokaryotes $\begin{cases} \rightarrow \text{Archaea} \\ \rightarrow \text{Bacteria} \end{cases}$

-) Don't have definite nucleus.
-) Genetic material is dispersed in cytoplasm.
-) No membrane bounded organelles.

Phylogenetic Position

→ In 5-kingdom classification system.

Monera

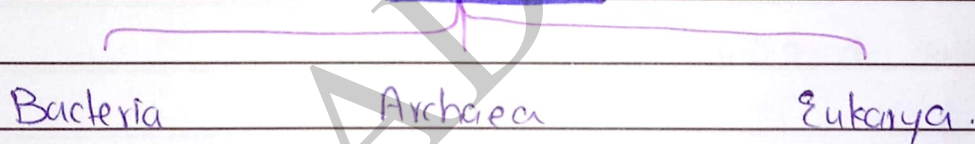


All prokaryotes (Bacteria + Archaea)

→ Domain System

Carl wrose invented 3 domain system in 1977.

Domains



★ Note ★

Domain
↓
kingdom

Division.

class

orders

family

genus

specie.

Archae

General Characteristics

2) Cell wall composition

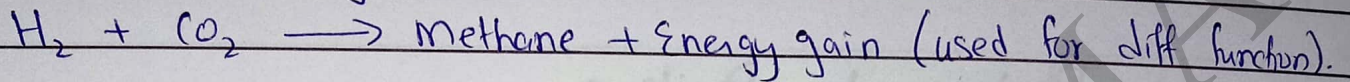
- ↳ some archaea lack cell wall.
- ↳ either composed of polysaccharide
- ↳ or protein

• Cell membrane composition

phospholipid → glycerol + Branched chain hydrocarbon
 (No true phospholipid cz of no fatty acids)

• Methanogenesis - Synthesis of Methane CH_4 .

Shown by some archaea



• Mode of nutrition

- lithotrophic (through methanogenesis).
- phototrophic (through sunlight).
- organotrophic (through organic comp.).

• No parasitic Nature

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Habitat of Archaea

↳ Mostly live in extreme env.

→ Methanogens Anerobic environment: {marshy places, swamps, gut}.
 eg Methanobacterium smithii

→ Halophiles Highly saline environment {salted fish or meat}
 eg Halobacterium halobium

→ Thermoacidophiles In extremely high temp & acid env. {hot spring, geysers}
 eg Thermoplasma acidophilum

Bacteria

Ecology and Diversity

Interaction of
 living org. with its env.

Variety
 (diff kinds of bacteria).

Occurrence

↳ Extremophiles High temp, High pressure, High pH, salty env.
 can survive extreme condition.

↳ Cosmopolitan It means they are found everywhere. (air, water ---).

Major Groups

Basis of classification:-

*** Note ***

Christian gram

⇒ Staining technique
 (Christian dye)

• Cell wall composition → Gram +ve (respond to Christian dye)
 → Gram -ve (doesn't respond, ").

• Endospores → endospore producing.
 → Not endospore produced.

• Metabolism → Aerobic
 → Anerobic
 → Photosynthetic

• Growth & nutritional.

• Physiological characteristics

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Bacteria Structural Features

- ⇒ **Flagella** Locomotory organ
help bacteria to move towards better optimal conditions.
- ⇒ **Pili** Adhesive Capability
hair like structure, helps in attachment, colony formation.
- ⇒ **Endospore forming ability** Survival strategy
 - ↳ Survival strategy (resistant structure).
 - ↳ form spores inside the body to survive harsh conditions.
- ⇒ **Filaments / chain formation** bridge gaps in soil particles
 - ↳ unique to actinomycetes. (In soil of breakdown of organic substances).
 - ↳ fill gaps in soil particles.

Cynobacteria Photosynthetic Autotroph

— Blue Green algae

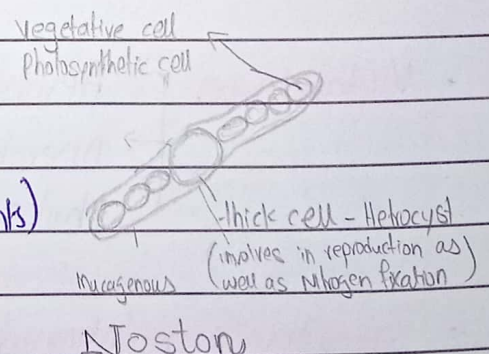
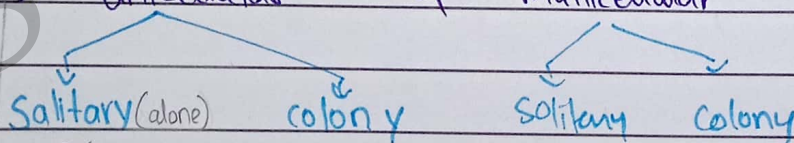
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Habitat / Occurrence

- 1) Damp soil
- 2) fresh water & marine water
- 3) Some of them are epiphytic (found on other plants)
- 4) Body structure resemble with algae.
5. Unicellular & Multicellular

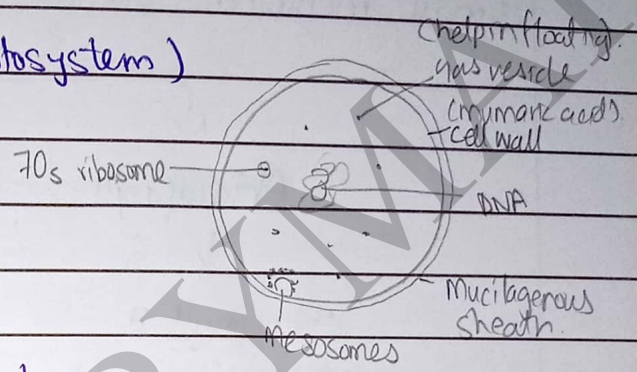


Cyanobacteria

Cell Structure - Prokaryotic Cell Structure

- ↳ Passive movement
- ↳ Mesosome - (cyanobacterial photosystem)

↓
 Electron carrier
 ↓
 photosynthesis



- ↳ mesosome + pigments → chromatophores

Cell Wall made up of muremic acid

Gas Vesicle help cyanobacteria in moving / floating (passive).
 not true organelles.

DNA in coiled form in cytoplasm.

Mucilaginous sheet (slippery) provides protection.

Ribosomes 70s in cytoplasm.

Mesosome ↳ present in cytoplasm.
 ↳ act as e⁻ transport carrier, in (ETC).
 ↳ photosystem of cyanobacteria.

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Pigment Composition

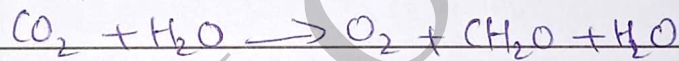
Chromatophores → cluster of pigments → Associated with small membranous structure. mesosome.

Chlorophyll
 ↓
 chlorophyll a
 (Bluish green)

phycobillin
 ↓
 phyocyanin
 (Blue coloured)

↳ Oxygenic photosynthesis

Cynobacteria



↳ true chlorophyll a

↳ phycobillin

↳ Noncyclic photophosphorylation

In other bacteria

→ H_2S instead of H_2O

→ bacterial

chlorophyll

*** Note ***

Nitrogen fixing Capability



1) Free nitrogen fixers (Not symbiotic)

2) Heterocyst → Nitrogen fixation (added in soil purposely)

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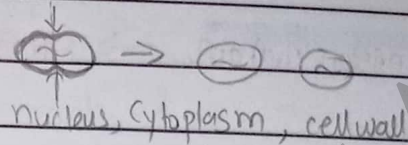
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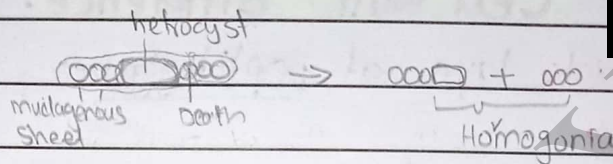
Asexual Reproduction Cyanobacteria

1) Cell Division

unicellular

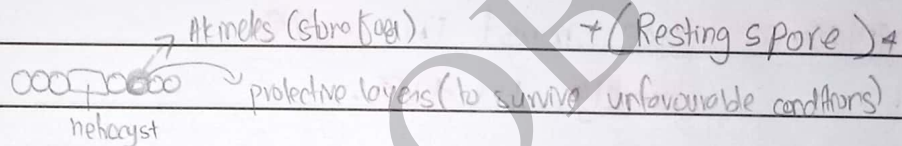


2) Fragmentation

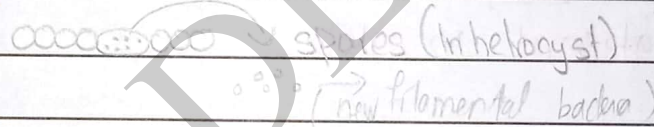


3) Akinetes

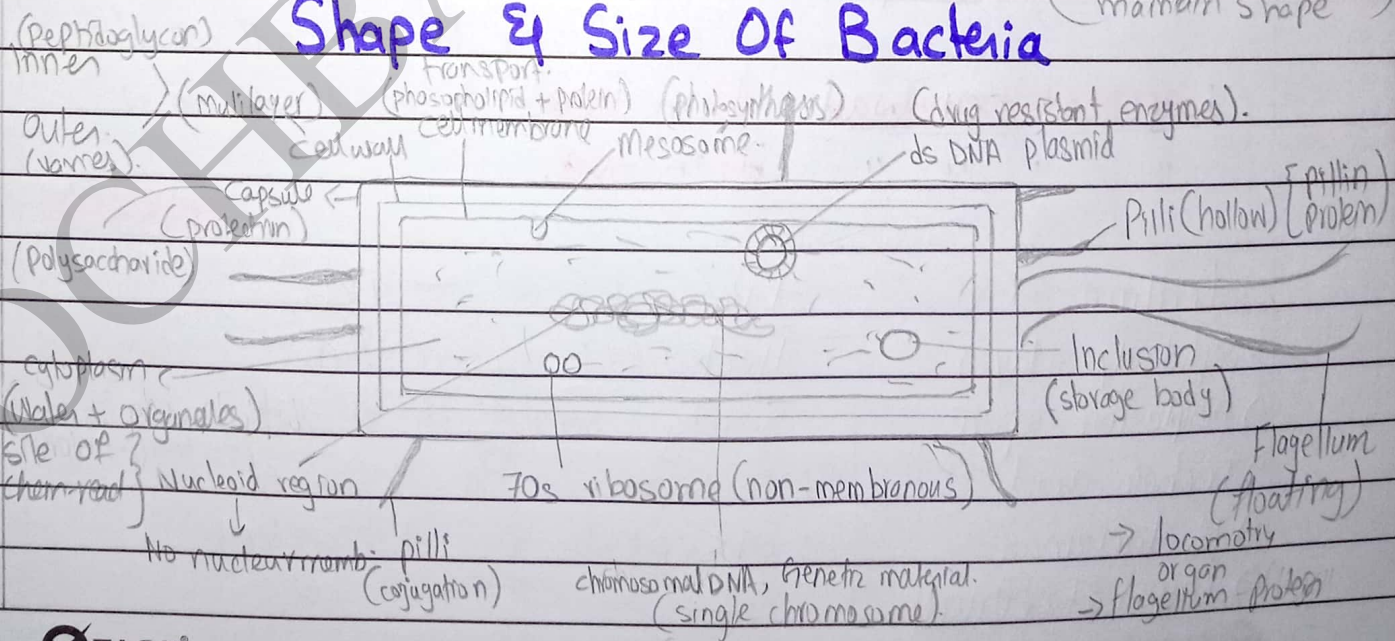
(only in vegetative)



4) Spore formation



Structure Shape & Size Of Bacteria



Gram Positive & Gram Negative → resistant

* Many bacterial properties depend on cell wall.

Christen Graham → Gram staining

- (crystal violet) (CV) → primary dye → Purple → reacts → +ve
- (iodine) → secondary dye → Pink → not react → -ve
- (Safarinn)

Cell Wall difference.

+ve, have thick layer of peptidoglycon.

-ve, " thin " " " "

Periplasmic space must in -ve

" " rarely in +ve.

Techoric acid present in +ve

" " absent in -ve.

β lactamase only in -ve

" " not present in +ve.

layer of cell wall 1 in +ve

" " " " 2 in -ve.

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Feature

- 1) peptidoglycon layer
- 2) periplasmic space
- 3) Techoric acid
- 4) β lactamase
- 5) layer of cell wall

+ve

thick

rarely

present

absent

1

-ve

thin

present

absent

present

2

Diversity & Shape and Size

Size

Smallest: phytoplasm - infects plants.
mycoplasma - infects animals.
 spherical in shape, $\approx$ diameter. $1 \mu\text{m} - 200 \mu\text{m}$ ($0.1 - 0.2 \mu\text{m}$)

Average: E. coli $1-2 \mu\text{m}$ length - $1.8 \mu\text{m}$ diameter - mostly humans
Spirilla $2.50 \mu\text{m}$ - infect kettles.

Largest: Epilopiscium fishelsoni $80 \mu\text{m}$ thick, $600 \mu\text{m}$ long

Shape

Cocci $\rightarrow$ spherical ○

Bacilli $\rightarrow$ Rod —

Spirilla $\rightarrow$ spiral ↻

pleomorphic $\rightarrow$ Not specific / exist in more than 1 shape

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Diversity

↳ On the basis of no. of cell in arrangement.

↳ on the basis of plane of division. (vertical / Horizontal)

Cocci

2 div. it $\rightarrow$ ○ $\rightarrow$ oo $\rightarrow$ diplococcus.

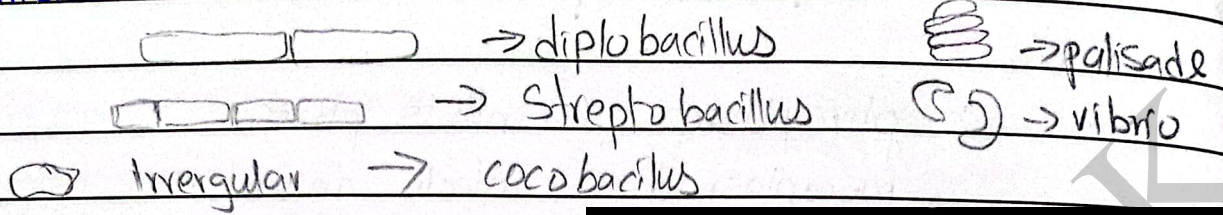
2 div. it $\rightarrow$ ○ $\rightarrow$ oooooo $\rightarrow$ streptococcus.

3 div. 2 vert. $\rightarrow$ ⊕ $\rightarrow$ ⊗ $\rightarrow$ tetrad

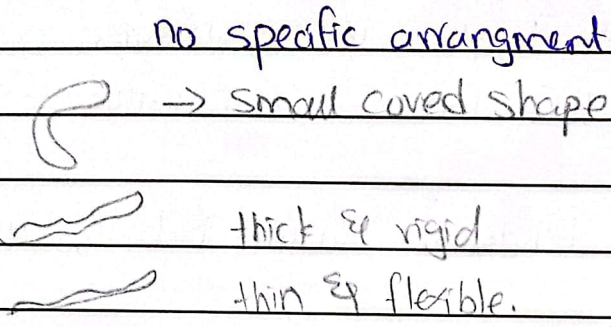
3 div. 1 hori. $\rightarrow$ ⊕ $\rightarrow$ ⊗ $\rightarrow$ sarcina / cubical

Irregular div $\rightarrow$ staphylococci

Bacillus



Spirilla



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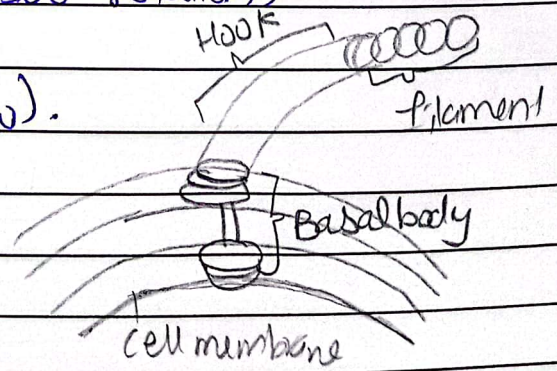
Structure Of Flagella

- Composition:** Flagium protein
- Size:** 20 nm in diameter, 20 μm in length.
- Non contractile** (unable to contract & relax).
- No cytoplasm** Just an extension outside bacteria.
- location** Beneath the cell membrane.

Parts

- Basal body** (pair of disc, rod, 360° rotation)
- Hook**
- Filament** (protein. helical / hollow).

* Flagella moves due to dis rotational motion. (360°).



Modes Of Nutrition In Bacteria

Autotrophs

Those bacteria that can prepare organic compound from inorganic substance.

Heterotrophs

Those bacteria that can prepare org. compounds from organic compounds.

Autotrophs

Photosynthetic

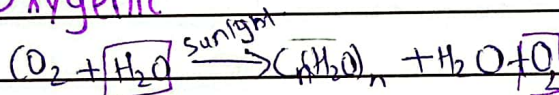
Oxygenic

anxygenic

Chemosynthetic

→ Get energy by oxidation of inorganic compound.

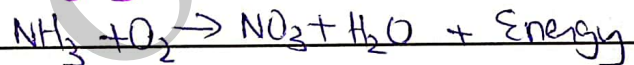
⇒ Oxygenic



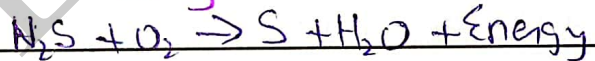
→ Cyanobacteria.

- Chlorophyll a

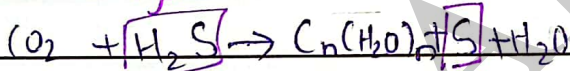
Nitrifying bacteria



Sulfur oxidizing bacteria



⇒ Non-Oxygenic



→ Green sulfur bacteria

→ purple sulfur bacteria.

- Bacterio chlorophyll

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Heterotrophs

Saprotrophs

→ Decomposers

Gain energy from dead organic matter.

eg

Pseudomonas

Azotobacter

Parasite

→ Pathogens

Obtain energy from other living beings & harm them. (disease).

eg

Streptococcus pneumoniae

Hemophilus Influenza

Obligate Parasite

• completely dependent on host for their life cycle.

eg

Rickettsia

Mycobacterium leprae

Facultative Parasite

• not completely dependent on host. can survive independently.

eg

E. coli

Pseudomonas aeruginosa

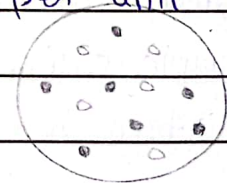
Bacteria Growth

Increase in no. of cells in a bacterial colony per unit time.

Phases

Lag phase

- preparatory phase
- Adapt to its new env.
- condition favourable.



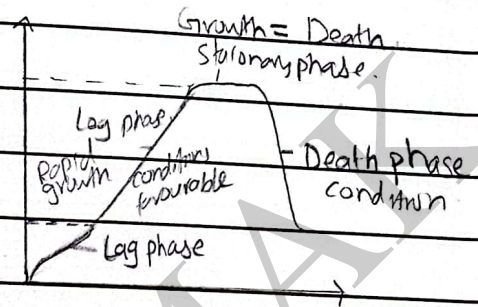
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Log phase

- Rapid Growth
- Cell begin to divide.
- Growth at exponential rate
 $2^0 \quad 2^1 \quad 2^2 \quad 2^3 \quad 2^4$
- Conditions are ideal for growth



Stationary phase

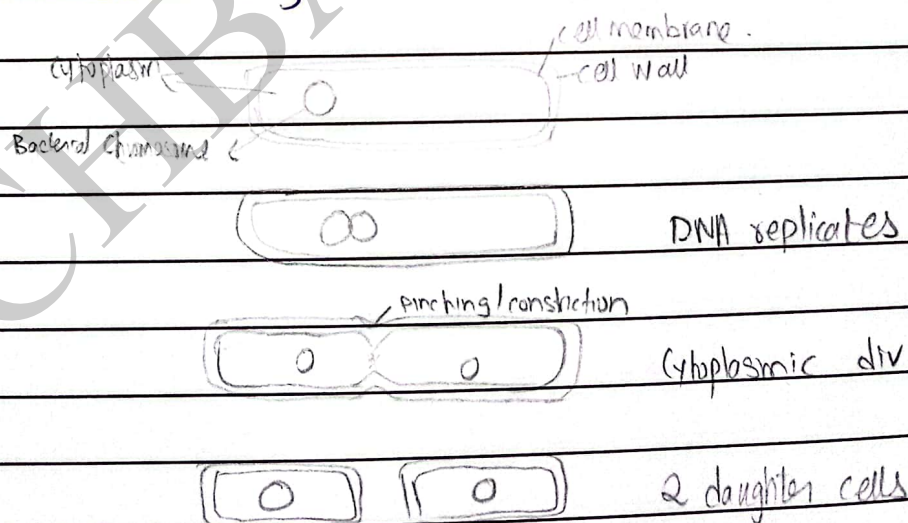
- Conditions are 50% favourable, 50% unfavourable.
- Growth rate = Death rate.
- No net increase in no. of cells in colony.

Death phase

- Conditions become unfavourable
- Death rate is faster than growth rate.
- Size of colony start decreasing.

Bacterial Reproduction

Asexual - Single Parent.



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