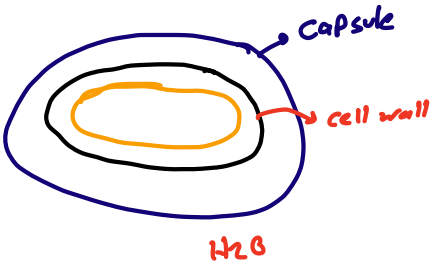
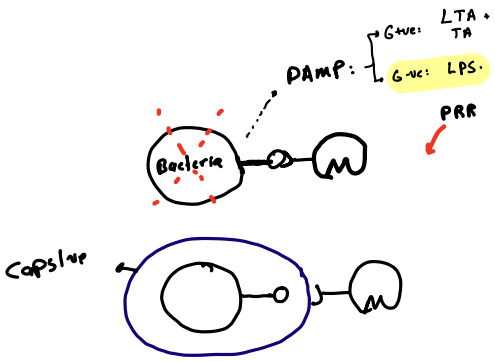
3 Bacterial structure, Nutrition, and Growth

* Capsule:



- Di / Poly saccharides OR polypeptides.
- Functions:
  1. water Binding ⇝ prevent dryness
  2. Anti-phagocytic.

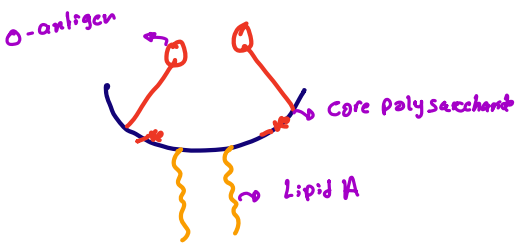


* Lipo poly saccharides: LPS

where? outer layer membran of g-ve.

3:

1. Lipid A:
   - Firmly embeded to the membrane
   - Stabilize the OM + Act as endotoxin



2. Core polysaccharide:
   -ve charges
3. O-antigen:
   protection

Endotoxin:

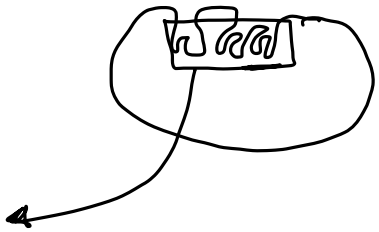
Lipid A released when cell lysis.

↑↑↑Cytokines → ↑ / ↓ → ↓B.P → Septic shock

(highly Immunogenic)

* Structures Internal to cell wall:

① Cytoplasmic membrane:



- Similar in Both G+ve & G-ve.

[2] Mesosomes:

- FXN? ↑ surface area for cellular respiration
- Site of oxidative phosphorylation
- Like cristae in mitochondria 

[3] Inclusion bodies:

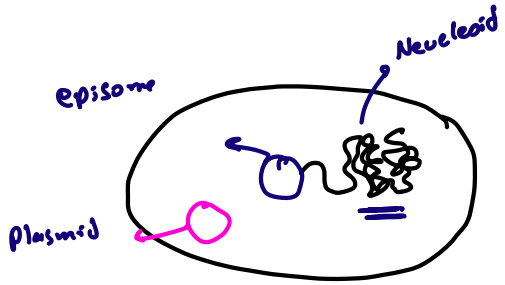
Granules / vacules store material for future use.

Ex:

- Glucose → Glycogen
- Lipid → PHB
- protein → Parasporal crystal
- Gases → Gas vesicles (buoyancy in Aquatic environment)

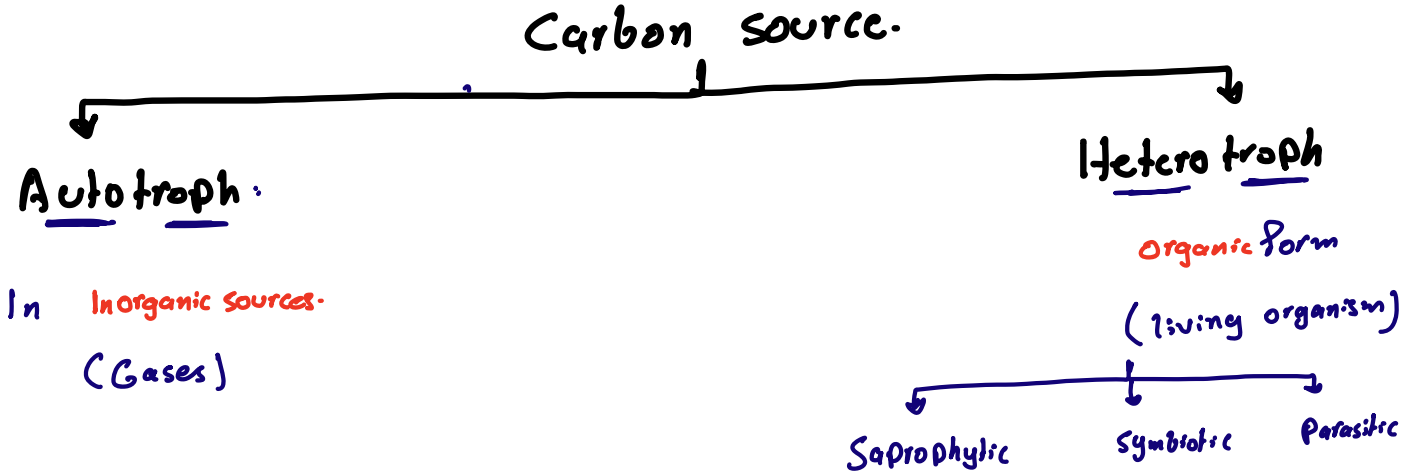
[4] Plasmid vs Episomes.

- Plasmid: Can't Integrate.
- Episomes: Can Integrate into the genome



- extrachromosomal DNA element
- proliferate Independently.

[2] Nutrition:



Types of Hetero trophic Bac.:

① Sapro phytic Bacteria:

- Dead Organic compounds

[2] Symbiotic Bacteria:

- Symbiosis (Beneficial partnership)
- Ex: Bacteria in the root.

[3] Parasitic Bacteria:

Feed on living tissues.

3 * Bacterial Reproduction:

- Asexuall (vegetative)

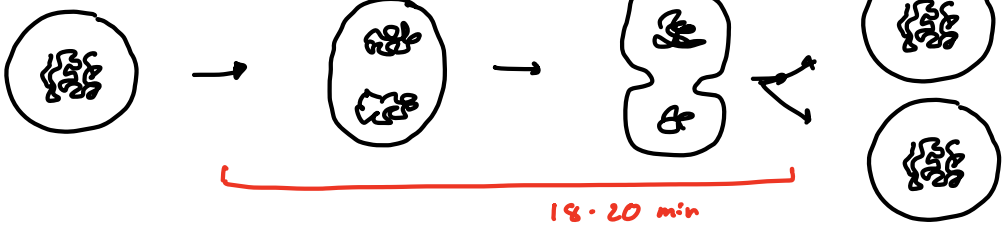
Sexuall ??

* Bacterial Growth = ↑ in # Not Size

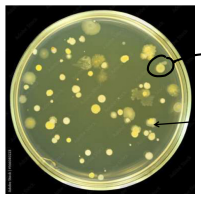
need:
Space, Food, water, O2
↓ waste product
Light, Temp (Appropiate)

* 1% survival rate of Bacteria

Binary fission:



18-20 min



only ↑ in # Not size.

Growth Stages

Lag phase:

- Adjustment
- Little growth

Exponential / log phase.

Maximum growth,
as long as
Nutrients are Adequate
& favorable enviroment.

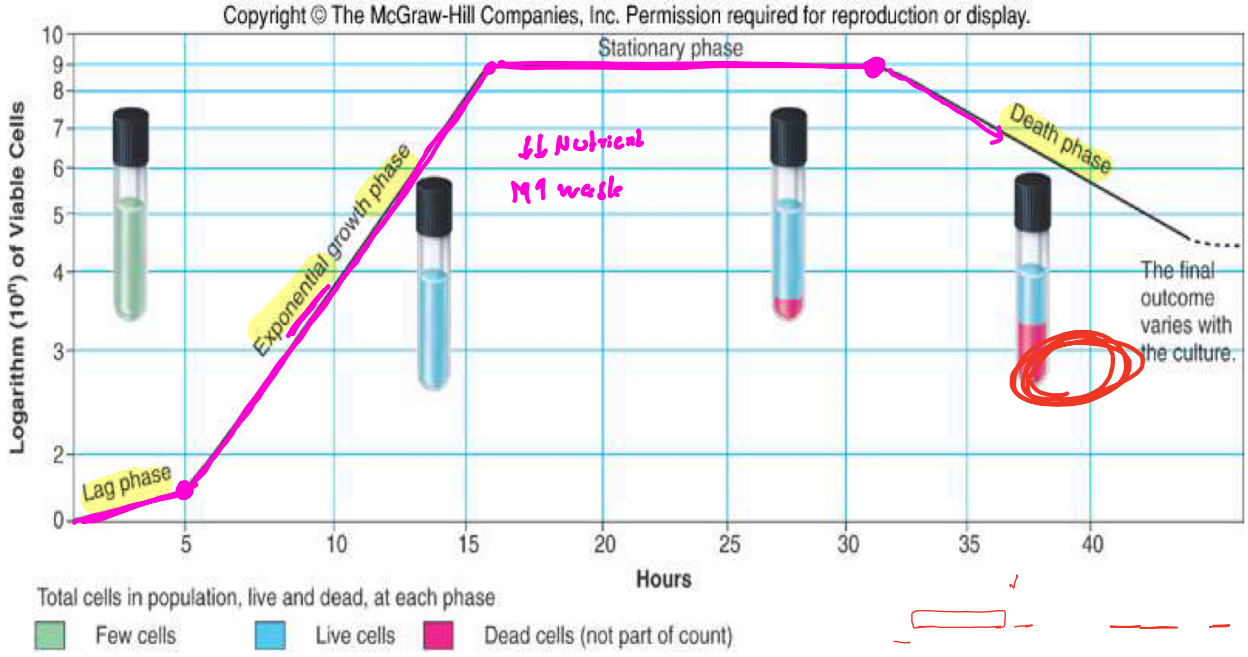
Stationary Phase

Growth = Death

↓ Nutrient
↑ wastes

Death Phase

Death > Growth



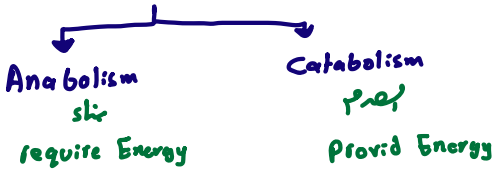
Character	Endotoxins	Exotoxins
Definition	are the lipopolysaccharide-protein complexes, produced at the time of cell death.	are polypeptide proteins excreted by few species of bacteria
Location	It is a part of the cells and located on chromosomal genes	It is released from the cells and located on extrachromosomal genes (e.g. plasmids).
Toxicity	Endotoxin is moderately toxic	Exotoxin is highly toxic
Source	It is produced after the disintegration of the gram-negative bacteria	It is produced in the living gram-positive bacteria and gram-negative bacteria
Boiling	It does not get denatured on boiling	It gets denatured on boiling
Diseases	Meningococcemia, sepsis by gram-negative rods, etc.	Botulism, Diphtheria, Tetanus
Effects	general symptoms are fever, diarrhea, vomiting etc	cytotoxin, enterotoxin or neurotoxin with defined action on cells or tissues.
Neutralization	cannot be neutralized by antibodies	can be neutralized by antibodies
Vaccines	No effective vaccines are available	effective vaccines are available
Examples	Toxins produced by E.coli, Shigella, Vibrio cholera, Salmonella Typhi	Toxins produced by Staphylococcus aureus, Streptococcus pyogenes, Bacillus anthracis, Bacillus cereus.

4 Bacterial Growth &Metabolism

Definitions:

* Bacterial Growth: ↑ in number NOT Size.

* Metabolism : Sum of chemical reaction.



Growth Requirment

- Physical req. (بظروف الحيوية)
  - Temprature
  - pH
  - osmotic pressure.
- Chemical req.
  - Carbon
  - O_2.

* Physical requirment:

① Temprature:

- Psychrophiles
  - True psychrophiles
    - 15° or less
    - Dont cause Disease or food spoilage ?
  - Psychrotroph
    - 20° - 30°
    - Responsable of most Low Temp. Food spoilage.
- Mesophiles:
  - 37° (25-40)
  - ✱
- Thermophiles:
  - 50° - 60°
  - (Hot spring sunlit soil)
  - Extreme thermophiles:
    - ↑ 80°
    - (Archea Bacteria)

② PH :

- Acidophiles
  - low pH (0.1 - 5.4)
  - Ex: H.pylori + Lacto Bacillus
- Neutrophiles:
  - 5.4 - 8.5
- Basophiles:
  - ↑ pH (17)
  - Ex: vibrio. cholera (pH=9)

③ Osmotic pressure: (تركيز الاملاح)

- Halophiles
  - 3.5 % Salt
  - Ex: Bacteria in oceans
- Extreme /obligate Halo philes:
  - 20 - 30 % Salt
  - Dead Sea
- Facultative Halophiles:
  - Use salt if present

Chemical requirments:

① Carbon:

- Back Bone of all organic compounds / 50% of Dry weight of cells.

  - Chemo hetero trophs : organic
  - Chemo Auto trophs : CO_2

[2] Oxygen:

- **Aerobes**: use & detoxify O_2
  - Obligate Aerobes (اجباري): Can't grow without O_2 — $O_2 O_2 O_2$ Top — Top — Enzymes — SOD: ✓
  - Facultative anaerobes: use O_2 if present — ✓ — ✓
  - micro aerophilic: require small amount of O_2 — O_2 O_2 ← X ← ✓ ← X — Below the Top — ↓ enzyme — ✗ *
- **Anaerobes**: Don't use O_2
  - Obligate anaerobes: Can't grow with O_2 — Bottom — X enzymes — ✗
  - aerotolerant anaerobes: Don't use O_2, but can tolerate it — Enzymes. — ✓

* O_2 & Free radicals:

- H_2O_2 : hydrogen Peroxide
  - ① Catalase: $H_2O_2 \rightarrow H_2O + O_2$ (gases)
  - ② Perioxidase: $H_2O_2 + H \rightarrow H_2O$ only
- O_2^- : superoxide
  - (superoxide dismutase): $2(O_2^-) + 2H^+ \xrightarrow{SOD} H_2O_2 + O_2 \xrightarrow{Catalase} H_2O + O_2$

* Bacterial Respiration: