BACTERIA

"If you don't like bacteria, you're on the wrong planet."

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Bacteria – the bad and the beautiful

Facts :

- **Bacteria are present almost everywhere from deep in the earth's crust to the polar ice caps and oceans to inside the bodies of plants and animals.**
- **There are more bacteria in your mouth than there are people in the world.**
- **Electronics, cellphones, laptops, keyboards etc. hold a lot of bacteria. Single smartphone screens hold 18 times more bacteria than a toilet handle.**
- **Smell of rain is caused by a bacteria called actinomycetes.**
- **Sweat itself is odourless. It's the bacteria on the skin that mingles with it and produces body odour.**
- **Horseshoe crab blood is worth US $15000/ L due to its ability to detect bacteria.**
- **Gonorrhea bacteria is the strongest creatures on the earth as they can pull 100,000 times their own weight.**

Introduction

- Bacteria were discovered by Antonie van Leeuwenhoek in 1676.
- They are the primitive forms of life.
- They are monerans and comprises a group of prokaryotic organisms which is characterized by:
  - Peptidoglycan wall
  - Compacted but naked DNA with attached mesosome
  - Reserve food material made up of glycogen and fats
  - Gas vacuoles may occur
  - All membranes bond cell organelles completely absent
  - 70S Ribosome occurs
- They have varied forms of nutrition.

Antonie van Leeuwenhoek
(1632-1723)

Bacterial Nutrition

Heterotrophic
(Take in food)

Autotrophic
(make food)

Saprophytic
e.g.
bacteria
of decay

Parasitic
e.g.
Streptococci

Photosynthetic
e.g.
Purple
sulphur
bacteria

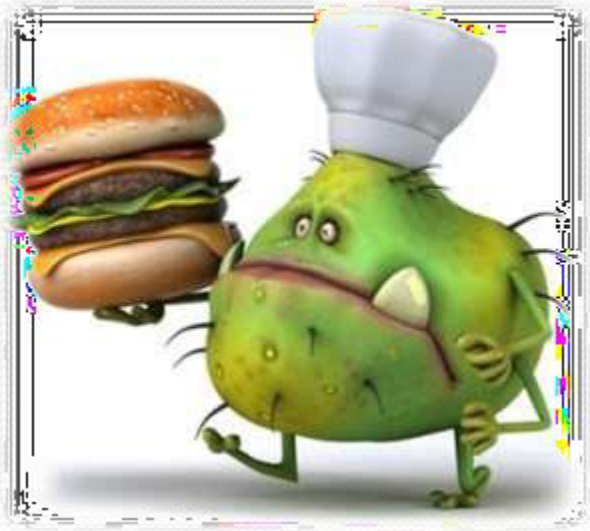
Chemosynthetic
e.g.
Nitrifying
bacteria

Nutrition and growth

1. **<u>Autotrophic</u>** producer, makes energy from environmental sources.
   - ❑ Chemoautotrophs-Take hydrogen from NH_3 or H_2S and oxidize it using the energy to make amino acids & protein.
   - ❑ Photoautotrophs – photosynthetic bacteria uses sunlight for energy.
2. **<u>Heterotrophic nutrition</u>**

___feed on organic material formed by other organisms.

- Parasites & Decomposers.
- Secrete enzymes in their organic environment and then absorb the nutrients and metabolize their host.



BACTERIAL RESPIRATION

Aerobic bacteria

(Obligate aerobes)

They require free oxygen to carry out cellular respiration

Obligate anaerobes

They do not require free oxygen for cellular respiration.

Obligate anaerobes

They cannot live in the presence of O_2

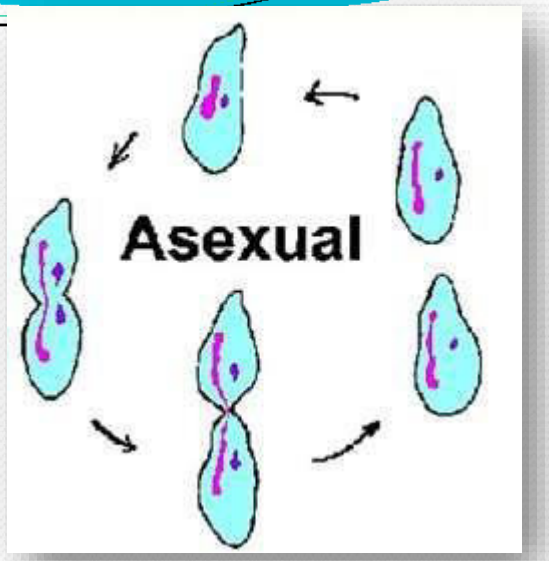
Facultative anaerobes

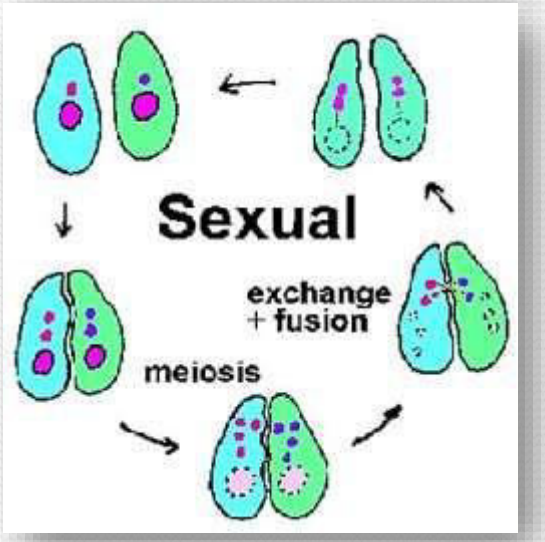
They can live in either the presence or absence of O_2

Reproduction

Bacteria can reproduce by many modes:

- Asexual mode
  - Fission
  - Spore formation
- Sexual mode
  - DNA transfer

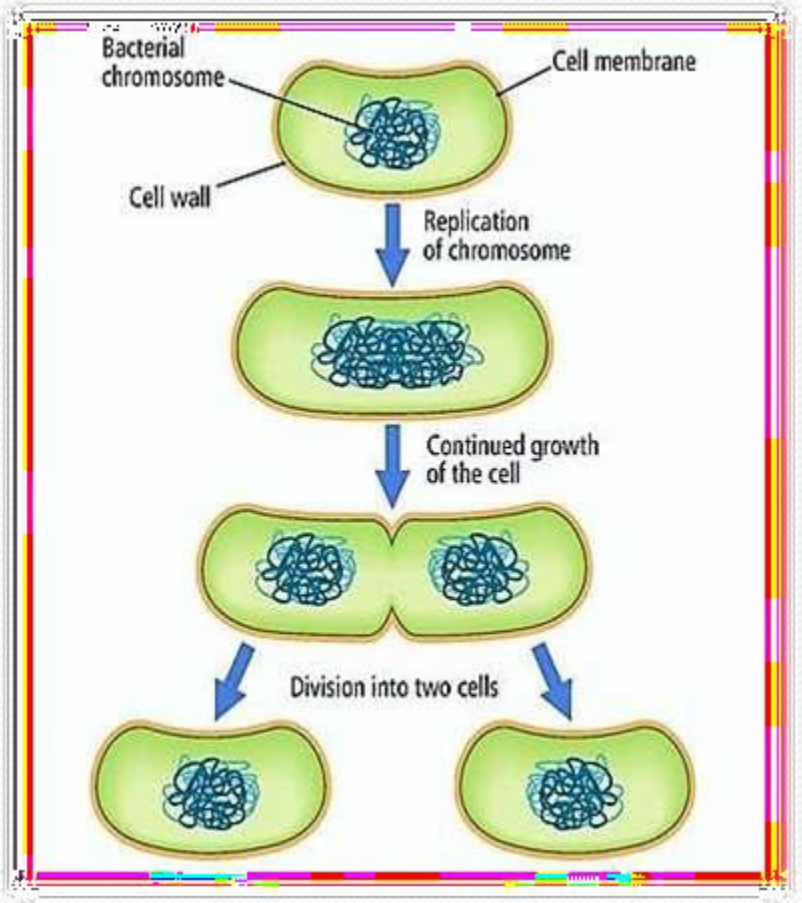




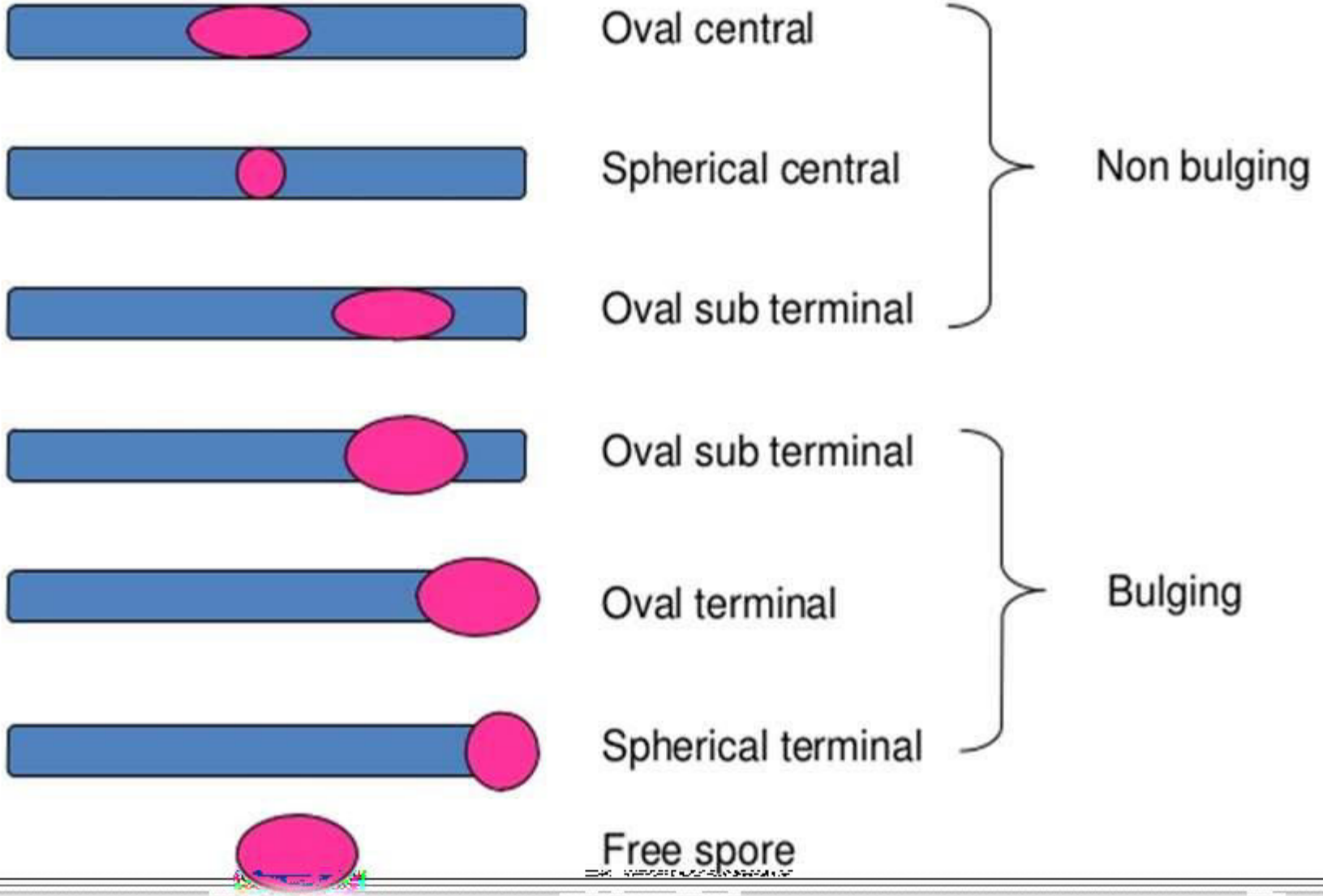
Asexual reproduction

1. Binary fission

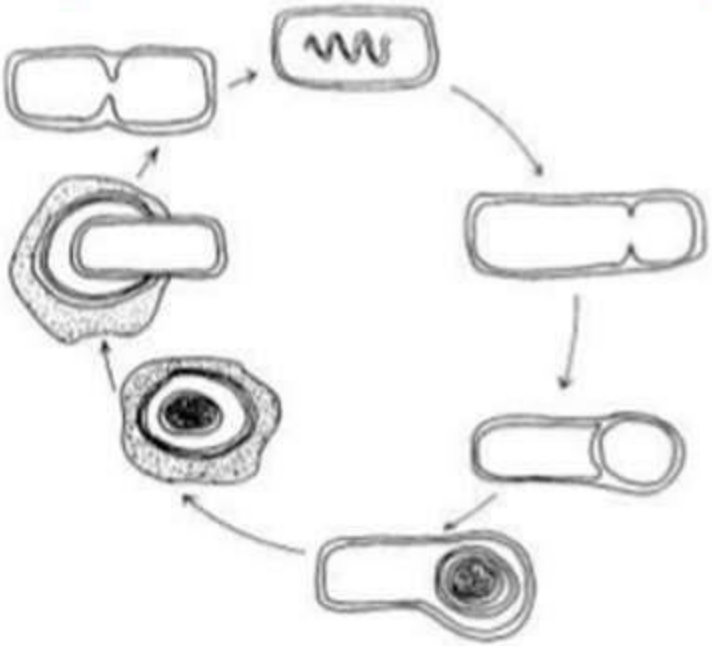
- Bacterial cell elongates and splits into two daughter cells , each with identical DNA to the parent cells.
- General method of reproduction.



Shape & position of bacterial spore



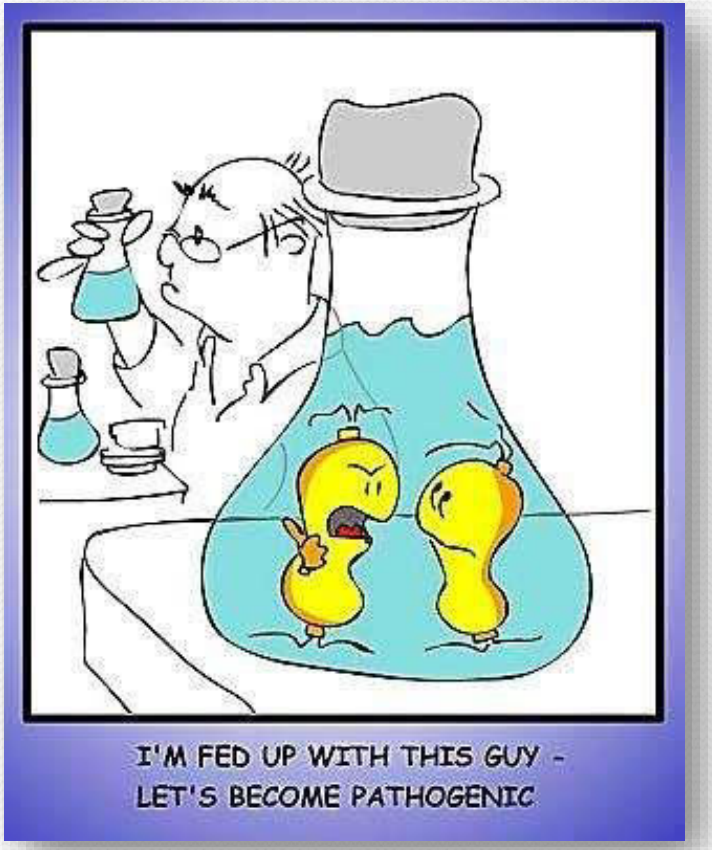
The cycle of spore formation and germination



At the beginning of spore formation, a septum forms, separating the nascent spore from the rest of the cell and all of the genetic material of the cell is copied into the newly-forming cell. The spore contents are dehydrated and the protective outer coatings are laid down. Once the spore is matured it is released from the cell. On germination, the spore contents rehydrate and a new bacterium emerges and multiplies.

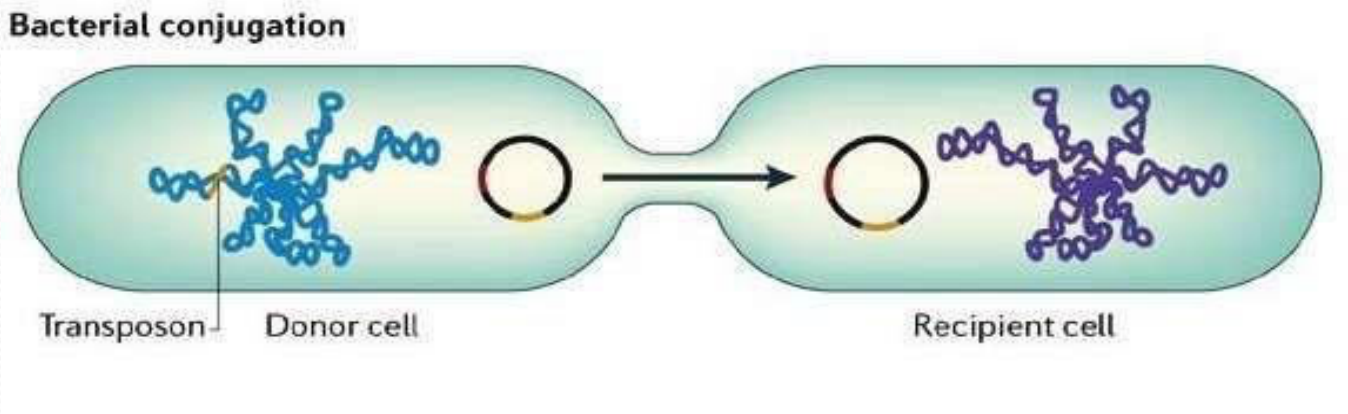
Sexual Reproduction

- Involves two parents who combine their DNA to produce a new organism.
- The new organism is different from both of the parents.
- Three parasexual mode of reproduction in bacteria:
  1. Conjugation
  2. Transformation
  3. Transduction



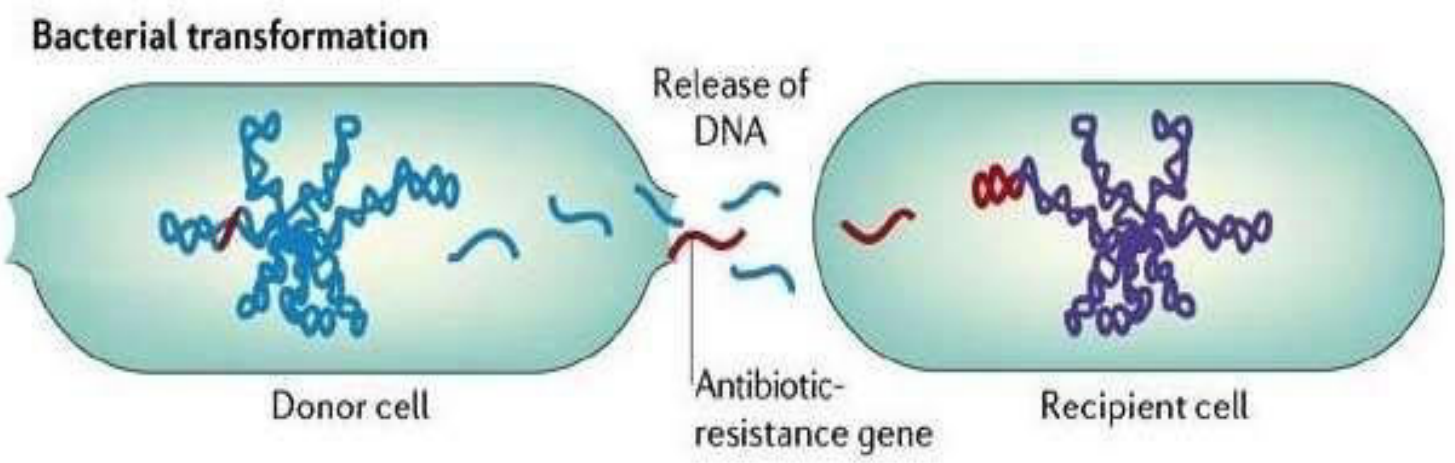
Conjugation

- It was first discovered in Escherichia coli by Lederberg and Tatum (1946).
- They found that two different types of auxotroph (nutritional mutants) grown together on minimal medium produced an occasional prototroph (wild type).
- Cell contact was required for this change. Anderson (1957) observed conjugation between two such bacteria under electron microscope.
- Conjugation was later reported in a number of other bacteria.
- Bacteria showing conjugation are dimorphic, i.e., they have two types of cells,
  1. male (F^+) or donor and
  2. female (F-) or recipient.



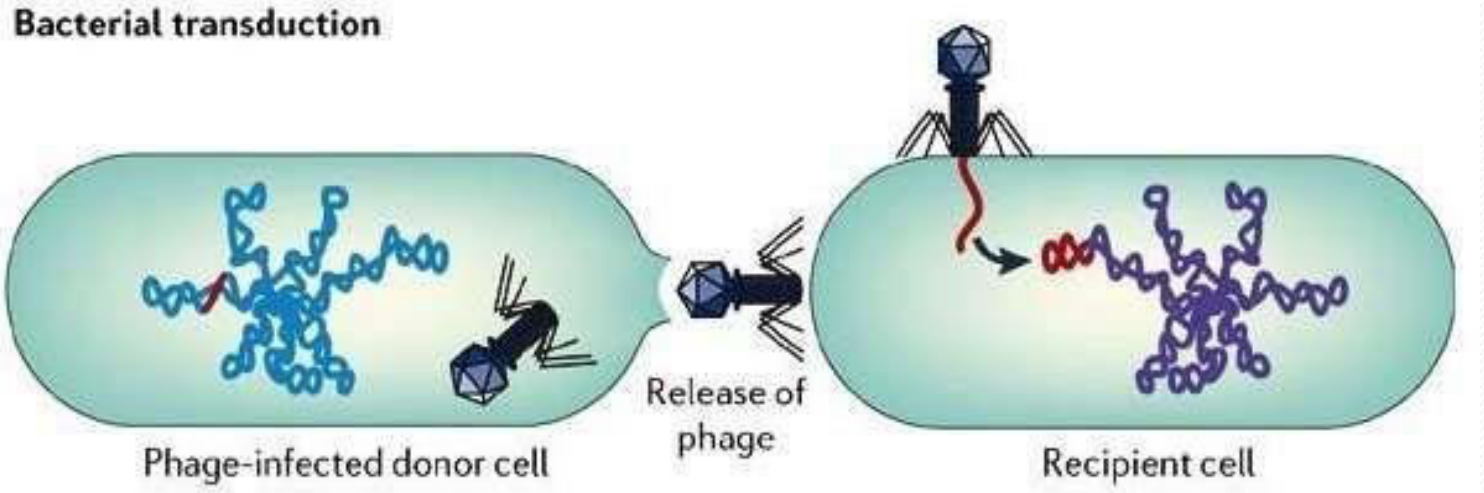
Transformation

- It is the absorption of DNA segment from the surrounding medium by a living bacterium. The phenomenon was discovered by Griffith in 1928. Its mechanism was worked out by Avery (1944).
- Receptivity for transformation is present for a brief period when the cells have reached the end period of active growth. At this time they develop specific receptor sites in the wall. Normally E. coli does not pick up foreign DNA but it can do so in the presence of calcium chloride.



Transduction

- Nutrition transfer of foreign genes by means of viruses.
- Transduction was first discovered by Zinder and his teacher Lederberg (1952) in Salmonella typhimurium.
- The process also occurs in E. coli and a number of other hosts. A virus may pick up gene of the host in place of its own gene during its multiplication in the host cell.
- Such a virus is never virulent. It passes over the gene of the previous host to the new host.
- Transducing viruses may carry the same genes (restricted transduction) or different genes (generalized transduction) at different times.



Thank you