

Reproduction:

Reproduction is of two types

1. By asexual means
2. By sex-like process

Asexual:

Asexual reproduction does not involve the union of two compatible genetic materials

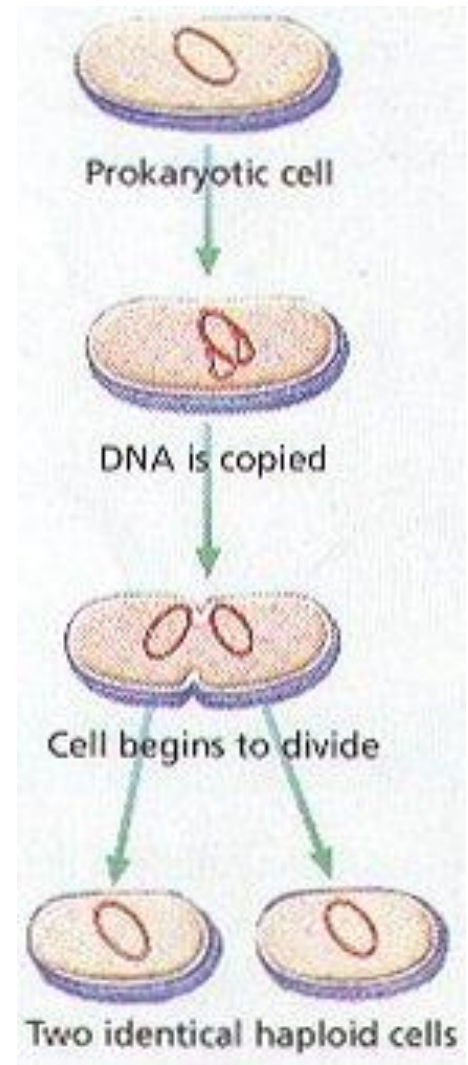
1. **Fission:** Bacterial cells divide into two, four or more cells. In one day about one million bacterial cells are produced by fission depending upon food availability and environment conditions.
2. **Binary fission:** Single cell produces two cells which are identical to their parents.
 - ✓ one parent involved
 - ✓ offspring are identical to parent & each other

Advantages:

1. simple: only 1 parent
2. offspring are fully formed (no maturation needed)
3. very fast (20 min. in ideal conditions)
4. after 24 hrs: 1 bacterium 2×10^6 kg of cells
(Enough to cover the earth)

Disadvantages:

- no genetic variety
 - one unfavorable environmental condition can wipe out whole population
3. **Endospores:** These are hard structures formed during the life-cycle of bacteria.
 4. **Cyst:** It is similar to endospore and have lesser resistance than endospore and even survive during winter and summer
 5. **Fragmentation-like process:** Group of bacterium known as *actinomycetes* are placed in fungi because of their way of reproduction like fungus.



6. **Conidia:** It is the reproductive unit in bacterium or fungus. Normally this term is used for fungus.

Sex-like processes:

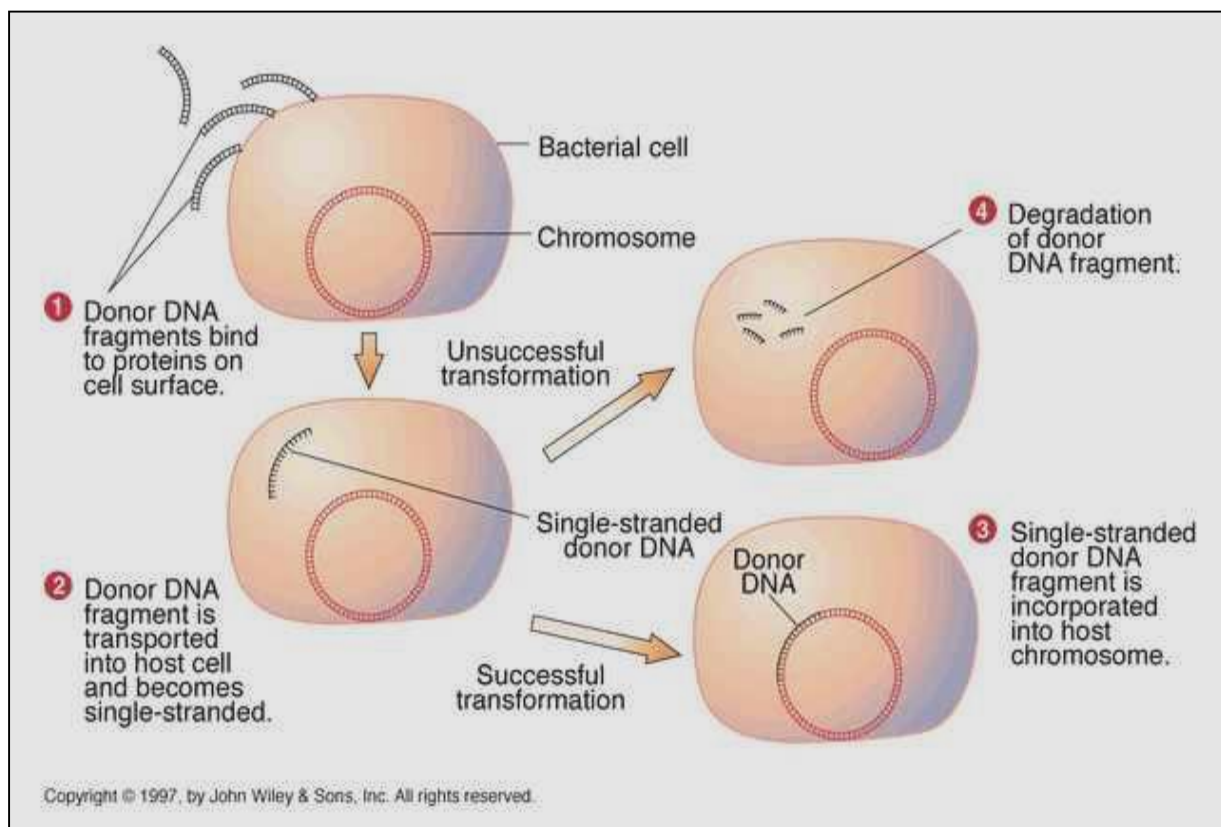
- ✚ Two parents involved
- ✚ Offspring are genetically different to parents & to each other

Advantages:

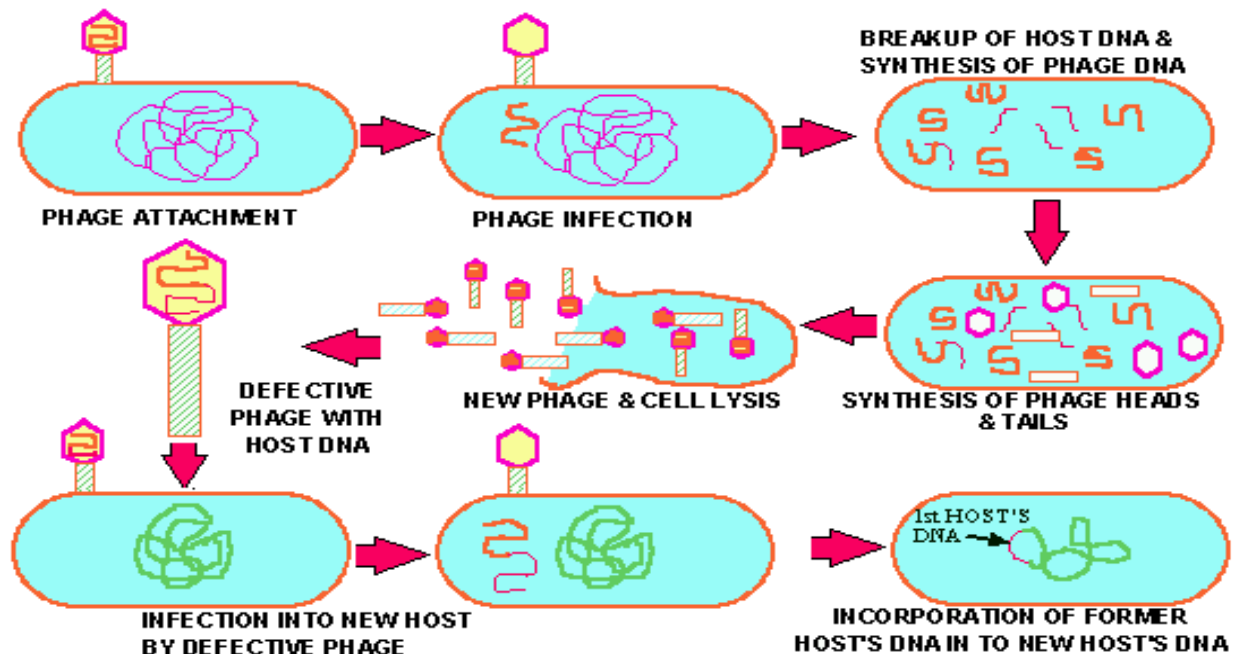
Genetic variety i.e. some are able to adapt to unfavorable conditions (*ex: antibiotic resistance*)

Disadvantages:

- More complex: slower because must find a compatible partner
 - No new individuals produced (*i.e. no increase in population*)
1. **Transformation:** The genetic alteration of a bacterium by the introduction or absorption of extraneous free DNA, esp. by means of a **plasmid**. It consist of 3 steps:
- a) External binding of the DNA fragments in to the cell membrane.
 - b) Penetration of the DNA fragments through the cell envelop.
 - c) Gene expression in the state of independent or integrated into the chromosomes of other cell.

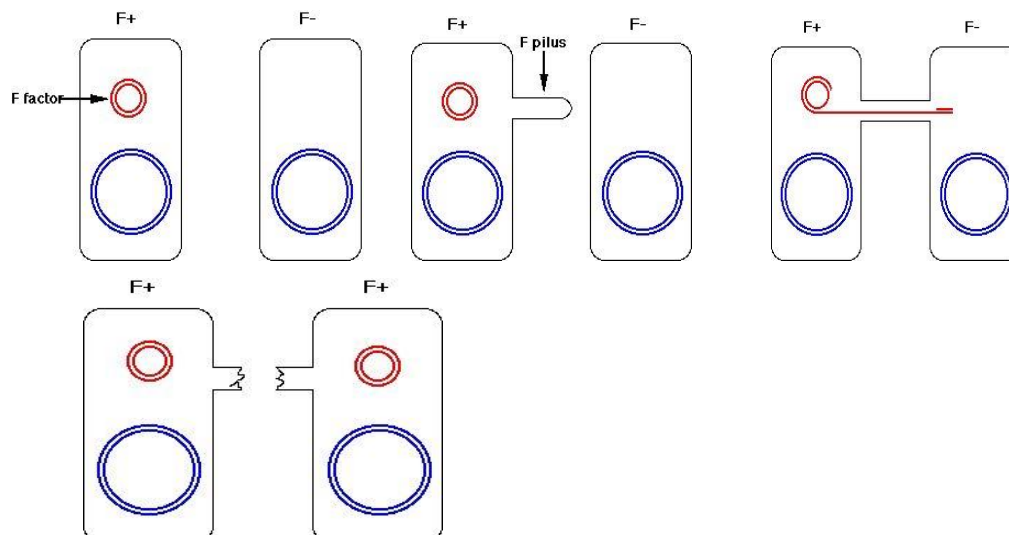


2. **Transduction:** Transfer of DNA from one bacterium to another through a virus called **bacteriophage**. When this phage is released from the host; they carry a very small portion of the **host chromosome**. This phage infects other cell; crossing over takes place between a fragment of chromosome of the donor cell and the homologous chromosome of the recipient cell.

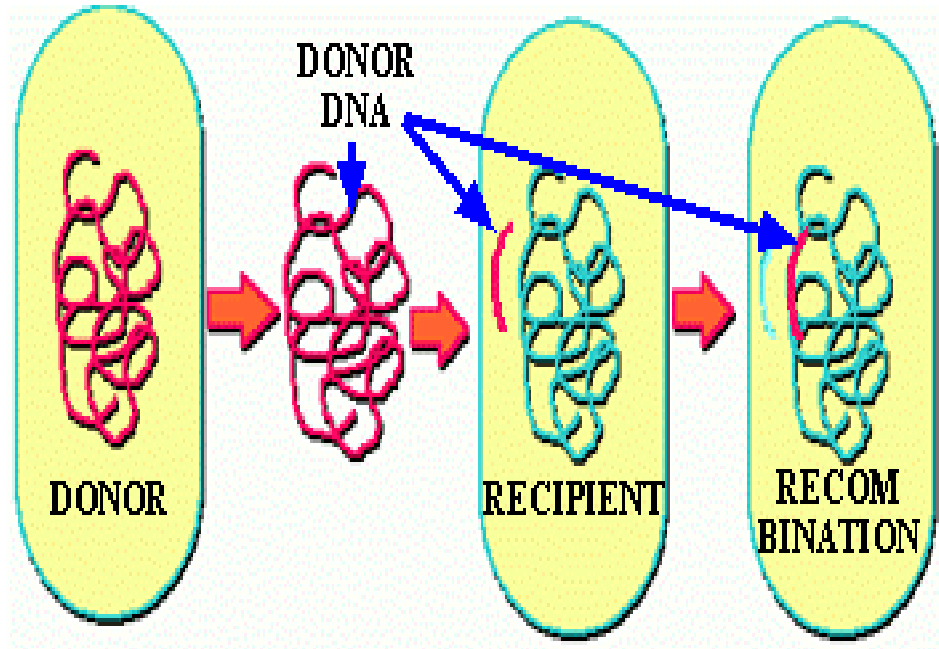


3. **Conjugation:** The ability of bacterial cells to transfer DNA between cells those are in **physical contact**. It is the transfer of DNA from one bacterium to another through physical cellular contact with specific structure **called sex pili**.

The sex plasmid genes are responsible for the synthesis of special pili called **sex pili**. Sex pili are thin long, hollow protein tubes that have "sticky" receptors on their ends that bind firmly to molecules on recipient cell walls. The recipient cell receives DNA from donor bacterium through contact.



4. **Genetic Recombination:** When DNA enters the recipient cell by any of three mechanisms. It can synapse the homologous region of recipient genome and undergo recombination to give new genome or new DNA different from original one.



NITROGEN FIXATION AND THE NITROGEN CYCLE

Adopted from **Martin F. Wojciechowski and Johanna Mahn**

In a symbiotic relationship with the soil bacteria known as '**rhizobia**', legumes form nodules on their roots (or stems to 'fix' nitrogen into a form usable by plants.

The process of biological nitrogen fixation was discovered by the Dutch microbiologist Martinus Beijerinck. Rhizobia (e.g., *Rhizobium*, *Mesorhizobium*, *Sinorhizobium*) fix atmospheric nitrogen or dinitrogen, N_2 , into inorganic nitrogen compounds, such as ammonium, NH_4^+ , which is then incorporated into amino acids, which can be utilized by the plant.

Plants cannot fix nitrogen on their own, but need it in one form or another to make **amino acids and proteins**.



Because legumes form nodules with rhizobia, they have high levels of nitrogen available to them.

Their abundance of nitrogen is beneficial not only to the legumes themselves, but also to the plants around them.