

Chapter-7 Bacteria

Very Short Answers Questions:

1. Write briefly on the occurrence of microorganisms?

A: Bacteria occur everywhere. They are found in soil, water, air, in living organisms and in foods. They also occur in volcanic ashes, arctic snow, hot water and sulphur springs. They live as parasites on plants and animals or symbiotic association with plants and animals.

2. Define microbiology?

A: Study of microorganisms that are too small to be seen with naked eyes and also concerned with structure, function, classification and ways of controlling and using their activities. Microbes include Protozoa, microscopic Algae and Fungi, Bacteria, and Viruses.

3. Name the bacteria which are common inhabitants of human intestine. How is it used in biotechnology?

A: *Escherechia coli*.

1. In biotechnology it acts as a host for many desired genes.
2. It provides restriction enzymes.

4. What are pleomorphic bacteria? Give an example?

A: Bacteria that keep on changing their shape depending upon the type of environment and nutrients available are called pleomorphic bacteria.

E.g. *Acetobacter*

5. What is sex pilus? What is its function?

A: It is a special conjugation apparatus also called as conjugation tube or pilus.

1. Pilus produced by F^+ bacteria make contact with the recipient cell (F^-) during conjugation.
2. It shortens and brings conjugating bacteria closer.
3. It acts as a conjugation tube for the transfer of a DNA copy from F^+ to F^- .

6. What is a genophore?

A: The main bacterial genetic material “bacterial chromosome” is called genophore. It is circular DNA.

7. What is a plasmid? What is its significance?

A: It is a small circular double stranded DNA present in addition to genophore in certain bacteria.

1. It confers protective traits to bacteria such as resistance to drugs and production of toxins and enzymes.
2. It participates in conjugation and transfers to recipient.

8. What is conjugation? Who discovered it and in which organism?

A: It is a type of sexual reproduction in which two live bacteria coming together and the donor cell directly transferring DNA to the recipient cell.

Leaderberg and Tatum.

Escherechia coli.

9. What is transformation? Who discovered it and in which organism?

A: It is a method of sexual reproduction in which uptake of naked DNA fragments from the surrounding and the expression of the genetic information in the recipient cell takes place.

Frederick Griffith.

Streptococcus pneumoniae.

10. What is transduction? Who discovered it and in which organism?

A: It is a form of sexual reproduction in which transfer of genetic material from one bacterium to another through bacteriophages (vector) takes place.

Lederberg and Zinder.

Salmonella typhimurium.

Short Answer Questions

1. How are bacteria classified on the basis of morphology?

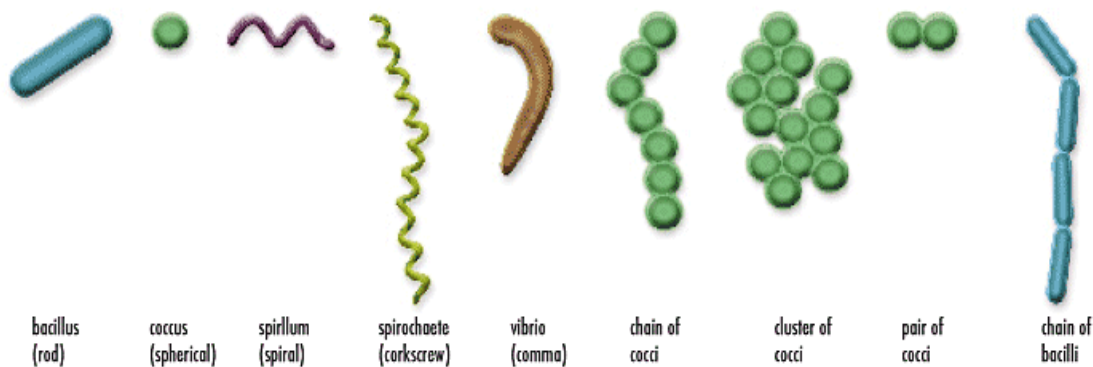
Ans: Morphological characters like Size and Shape are sometimes considered for classification.

Size may be small or large ranging from 2 to 5 μm in length and 0.5 to 1 μm in width.

Shape: Depending on the shape bacteria may be classified as:

1. **Cocci** – Spherical bacteria
2. **Bacilli** – Elongated rods
3. **Spirillum** – Helical rods
4. **Vibrios** – Comma shaped.

Few bacteria keep on changing their shape depending upon the type of environment and nutrient available- these are **Pleomorphic** bacteria. E.g. *Acetobacter*



Bacteria may occur individually or in groups. Based on the arrangement of cells in groups the bacteria can be classified as:

Coccus bacteria

1. **Monococcus:** A single coccus bacteria.
2. **Diplococcus:** A pair of cells adhere together.
3. **Tetrads:** A group of four cells.
4. **Streptococcus:** A linear chain of cells arranged in a single row of cells.
5. **Staphylococci:** Irregular pattern of cells producing bunches.
6. **Sarcina:** Cells arranged in cubes of eight.

Bacillus bacteria

1. **Monobacillus:** A single bacillus
2. **Diplobacillus:** A pair of bacilli adhered together.
3. **Stroptobacillus:** A chain of bacilli appearing like a straw.

Vibrios are spiral forms with less than one complete twist.

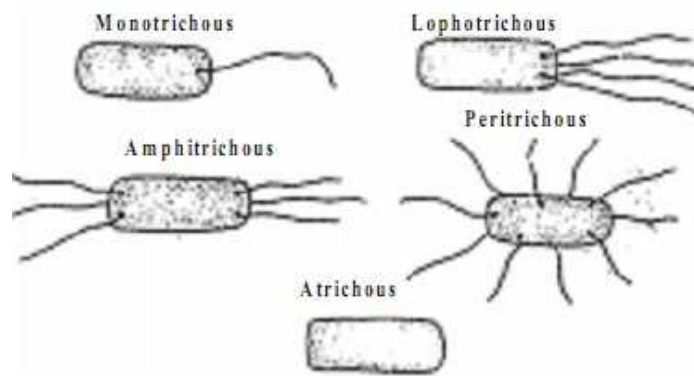
Cells with more than one complete twist with a distinct helical shape are called **Spirillum**.

Spirochetes are slender, long and **cork-screw** shaped.

2. How are bacteria classified on the basis of number and distribution of flagella?

Ans: Based on number of flagella Bacteria can be classified into

1. **Atrichous**
2. **Monotrichous**
3. **Lophotrichous**
4. **Amphitrichous**
5. **Peritrichous**



1. **Atrichous:** Bacteria without flagella are called as atrichous.
2. **Monotrichous:** Bacteria with single flagella at one end of the cell.
3. **Lophotrichous:** Bacteria with a tuft of flagella arising only at one end of the cell.
4. **Amphitrichous:** Bacteria with a single or many flagella at both ends of the cell.
5. **Peritrichous:** Bacteria with flagella distributed throughout the cell surface.

3. What are the nutritional groups of bacteria based on their source of energy and carbon?

Ans: Based on source of energy and carbon four major types of bacteria can be described

1. **Photoautotrophs**
2. **Chemoautotrophs**
3. **Photoheterotrophs**
4. **Chemoheterotrophs**

1. Photoautotrophs: are photosynthetic. They capture light energy and transform into chemical energy and obtain carbon from atmospheric carbon dioxide.

E.g: *Chromatium, Chlorobium*

2. Chemoautotrophs: They have an unusual nutritional adaptation, that require neither sun light nor organic nutrients. These bacteria derive energy from the oxidation of inorganic substances and carbon from carbon dioxide.

E.g.: *Nitrosomonas, Nitrobacter, Beggiotoa, and Methanogens.*

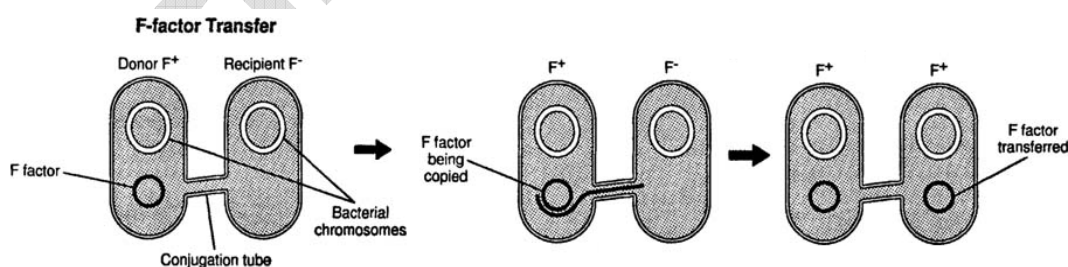
3. Photoheterotrophs: These bacteria obtain energy from light but carbon from organic sources.

E.g.: *Rhodospirillum, Rhodopseudomonas.*

4. Chemoheterotrophs: They derive both energy and carbon from organic sources. They are categorized into **Saprophytes** and **Parasites**. Saprophytes are free living and survive on dead and detritus organic matter (**E.g.:** *Bacillus*) where as parasites derive nutrition from cells and tissues of a host. **E.g.:** *Xanthomonas, Salmonella.*

4. Explain the conjugation in bacteria?

Ans: In this process two live bacteria come together and the donor cell directly transfers DNA to the recipient cell. This process was first observed in 1946 by **Lederberg** and **Tatum** in *Escherichia coli*.



The process of conjugation requires a special conjugation apparatus called the conjugation tube or pilus or sex pilus. For cell-to-cell contact, the **donor** cell designated as **F⁺** produces the pilus that makes contact with the **recipient** cell, known as an **F⁻** cell. The donor cell is called **F⁺** because it contains a plasmid called an **F plasmid**. The **F⁻** cell lacks an **F plasmid**.

Once contact is established, the pilus shortens and draw the two bacteria close together. The F plasmid then begins replicating and replicated DNA passes through the conjugation tube into the recipient cell.

Conjugation is a very conservative processes, in that the donor bacterium generally retains a copy of the genetic material being transferred.

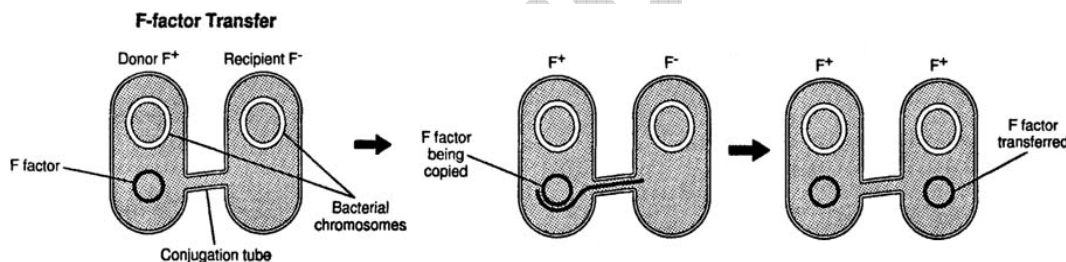
Long Answer Questions

1. Explain different methods of sexual reproduction in bacteria?

Ans: Sex organs and true sexual reproduction is absent in bacteria. The exchange of genetic material which is the essence of sexual reproduction takes place in three different ways.

1. Conjugation 2. Transformation 3. Transduction

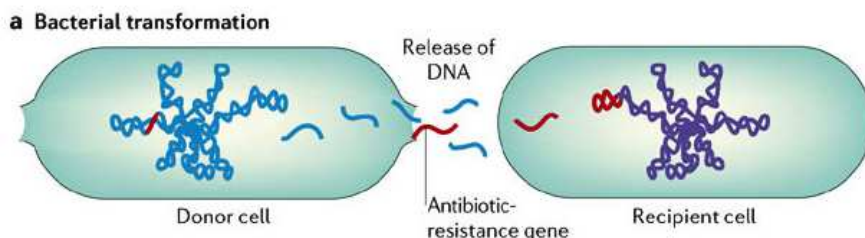
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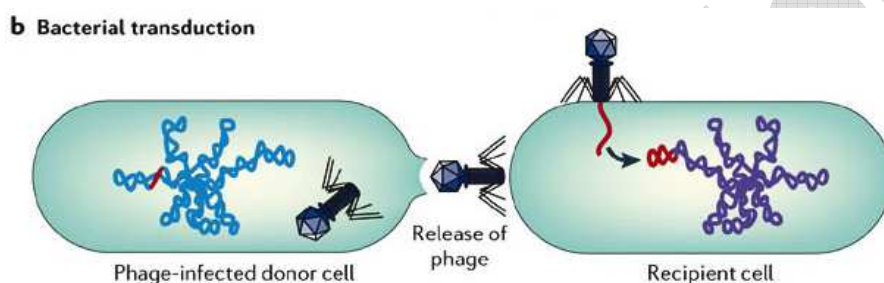
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2. Transformation: This mode of genetic recombination was discovered by **Frederick Griffith** in 1928 in *Streptococcus pneumoniae*?

Transformation is uptake of naked DNA fragments from the surrounding environment and the expression of that genetic information in the recipient cell. The recipient cell has now acquired a character that is previously lacking.



3. Transduction: This was discovered in 1951 by **Lederberg** and **Zinder** in *Salmonella typhimurium*.

The transfer of genetic material from one bacterium to another bacterium through a **bacteriophage (vector)** is known as transduction.

2. “Bacteria are friends and foes of man”-Discuss?

Ans: Bacteria are known agents of diseases in humans, plants and animals. At the same time many bacteria, directly or indirectly beneficial to humans. Due to this we can say “bacteria are friends and foes to man”. Bacteria decompose the dead animals, plants and recycle the nutrients of the dead bodies in the nature.

Some beneficial activities of Bacteria:

Many bacteria are beneficial to humans in **Agriculture, Industry, Medicine** and in **Biotechnology**.

Agriculture: Some bacteria recycle the nutrients and help maintain the fertility of the soil.

Ammonifying bacteria convert the proteins and amino acids of the dead bodies into ammonia. The process is called **ammonification** e.g. *Bacillus*.

Nitrifying bacteria oxidizes ammonia to nitrates. This is called as **nitrification** E.g *Nitrosomonas, Nitrobacter*.

Bacteria like *Rhizobium* symbiotically associates with leguminous plants and help in nitrogen fixation. Non-symbiotic bacteria like *Clostridium, Azatobacter, Azospirillum* and photosynthetic bacteria like *Rhodospirillum, Rhodomicrobium* also help in nitrogen fixation and enrich the soil nutrients and status of the soil.

Bacillus thuringiensis is used as bioinsecticide.

Industry: Many bacteria are industrially used in number of processes.

In fermentation process bacteria are used in production of industrial alcohol.

Bacteria are used in the fermentation of tobacco and tea leaves.

In leather industry and jute industry bacteria are used.

Many superior quality acids are produced using bacteria in the industry e.g are:

Acetic acid --- *Acetobacter aceti*

Butyric acid --- *Clostridium butylicum*

Lactic acid --- *Lactobacillu.*

To remove stains on cloths enzymes extracted from bacteria are used in laundry.

Methanogens are used in the **gobar gas** production.

In **mining industry** bacteria are used in mining of **Uranium**.

Biologically active **pollutants** can be detected by using bacteria as **Biosensors**.

Medicine: Many species of bacteria belonging to the genus *Streptomyces* are used in the extraction of various antibiotics e.g. *S.griseus, S.venezuelae*.

Digestive enzymes and amino acids extracted from bacteria are used as therapeutic agents.

Streptokinase, produced by the bacterium *Streptococcus* and modified by genetic engineering is used as '**clot buster**' for removing clots from the blood vessels of patients who have undergone myocardial infarction leading to heart attack.

Bacteria are essential for **sewage treatment** plants.

Biotechnology: Bacterium *Escherichia coli* is used as an experimental tool, cloning and as vector in biotechnology.

Agrobacterium tumifaciens is used as vector in developing **transgenic plants**.

Harmful activities of bacteria:

Some bacteria causes human diseases like

Clostridium tetani	-----Tetanus
Clostridium botulinum	----- Botulism.
Vibrio cholera	----- Cholera.
Salmonella typhi	-----Typhoid
Mycobacterium tuberculosis	----- Tuberculosis
Mycobacterium leprae	----Leprosy
Neisseria gonorrhoea	----- Gonorrhoea
Treponema pallidum	----- Syphilis

In plants **Blight of rice** is caused by **Xanthomonas oryzae** and **Citrus canker** is caused by *Xanthomonas pv citri*. In apples and pear **Crown gall** is caused by *Agrobacterium tumifaciens*.

As bacteria are both harmful as well as beneficial bacteria are aptly called as “friends and foes of man”.