Morphology of the Bacterial Cell

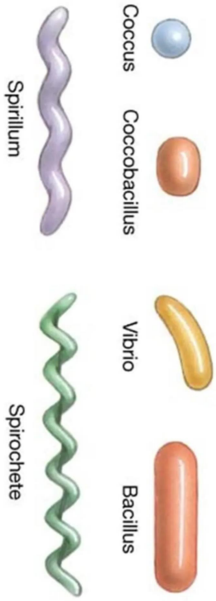
Introduction

Bacteria are unicellular prokaryotic microorganisms characterized by the absence of a nucleus and membrane-bound organelles. Their morphology is essential for identification and classification.

Morphology

Three criteria are taken into account:

1. Size; expressed in micrometers (µm)
2. Shape
3. Mode of assembly (**Associations or Arrangement)**



1.1. Main Shapes Sizes of Bacteria

Bacteria exhibit various shapes, which are used for their classification:

- **Shape**: Varies depending on the species

Some species have no fixed shape and are called polymorphic

- **Grouping**: Either

➔ Isolated

➔ Associated in particular ways

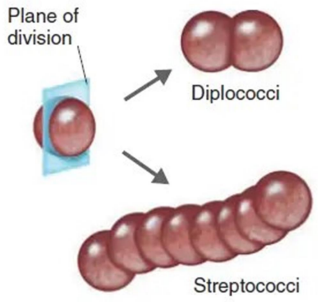
- Three main forms are distinguished:

1. **Spherical** or oval bacteria are called **cocci** (singular: coccus = grain, berry

Associations: Depending on the **mode** and **number** of dividing planes, cocci exhibit distinct arrangements. These arrangements are influenced by whether the daughter cells remain attached after division.

Cocci can be observed in:

- **Monococci** → *Monococcus*
- **Diplococci** (in pairs) → *Neisseria*

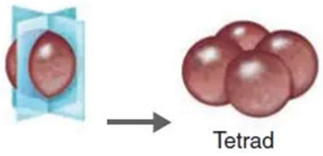


Diplococci arise when cocci divide and remain together to form pairs. Examples, *Neisseria gonorrhoeae, Neisseria meningitidis.*

- **Streptococci** (in chains) → *Streptococcus*

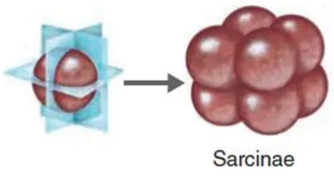
Long chains of cocci (streptococci) result when cells adhere after repeated divisions in one plane; this pattern is seen in the

genera *Streptococcus agalactiae, Streptococcus pyogenes, Enterococcus faecalis,* and *Lactococcus*.



- **Tetrads** (squares of four) → *Micrococcus*

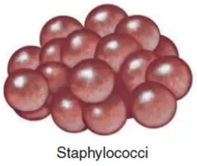
Members of the genus *Micrococcus* often divide into two planes to form square groups of four cells called tetrads.



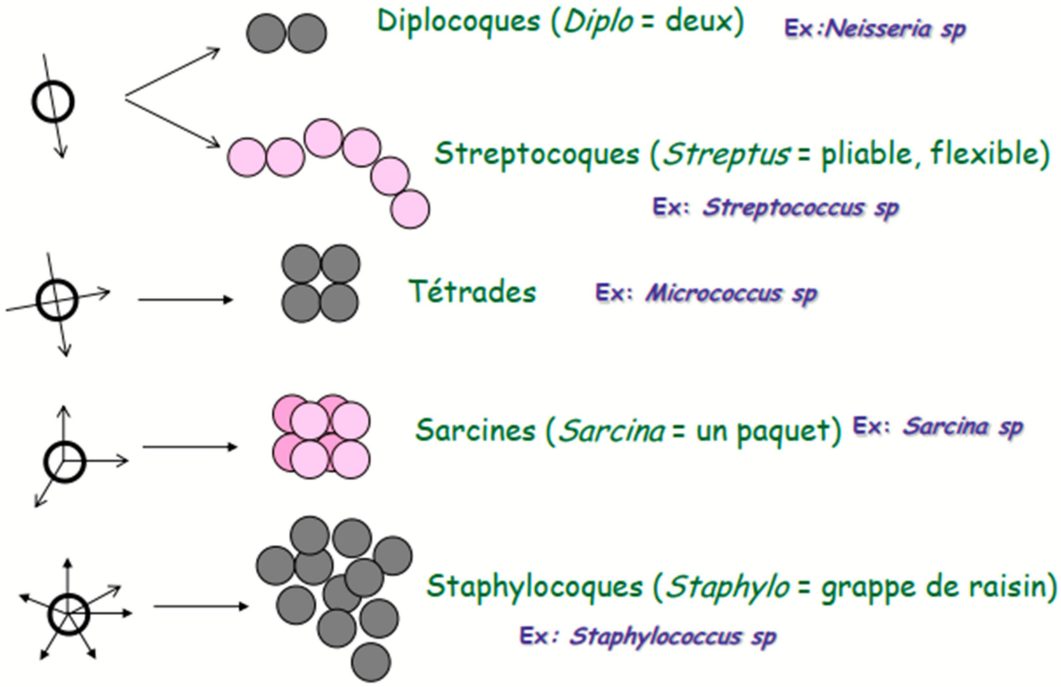
- **Sarcinae** (cubical groups) → *Sarcina*

In the genus *Sarcina,* cocci divide into three planes producing cubical packets of eight cells.

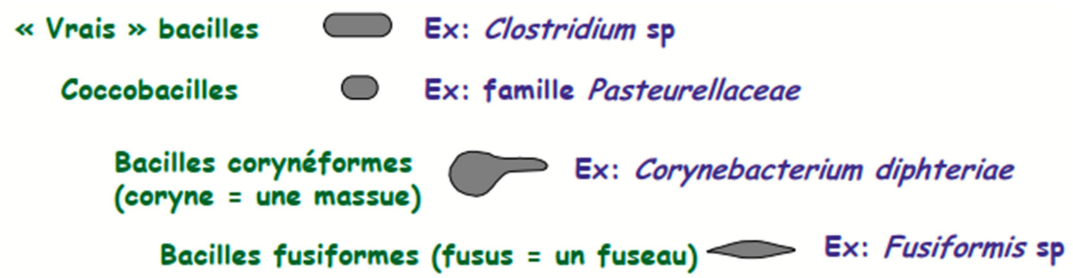
- **Staphylococci** (grape-like clusters) → *Staphylococcus*



Staphylococcus divides into random planes to generate irregular grapelike clumps. Divisions in two or three planes can produce symmetrical clusters of cocci. Examples, *Staphylococcus aureus, Staphylococcus saprophyticus, Staphylococcus epidermidis*, etc.



2. **Rods** are called **Bacilli** (singular: **bacillus**): Longer cocci
   - Single bacilli → *Escherichia coli*
   - Coccobacilli (intermediate between cocci and bacilli)
   - Coryneform (dumbbell-shaped)
   - Fusiform (Rod-shaped bacteria having tapered ends).



Arragement : These are not arranged in patterns as complex as cocci; most occur singly or in pairs (diplobacilli). But some species, such as *Bacillus subtilis*, form chains (streptobacilli); others, such as *Beggiatoa* and *Saprospira* species, form **trichomes** (which are similar to chains but have a much larger area of contact between the adjacent cells).

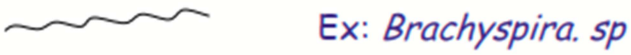
- Diplobacilli (in pairs)
- Streptobacilli (in chains)
- **Palisade arrangement** : In some bacillus, the cells are lined side by side like matchsticks and at angles to one another. Is found in *Corynebacterium diphtheriae.*

3. **Spiral-shaped:** Spiral bacteria have a variety of curved shapes. Bacteria with less than one complete twist or turn have a vibriod shape, whereas those with one or more complete turns have a helical shape. Spirilla are rigid helical bacteria, whereas spirochetes are highly flexible. Spirilla (singular: spirillum) are rigid, wavy-shaped curved bacteria, and spirochete is curved corkscrew-shaped bacteria.

- Vibrios (curved) → *Vibrio cholerae*

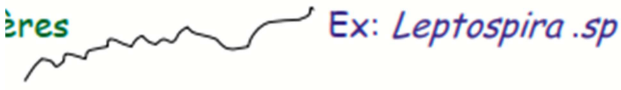
Spiral , **<u>Can be</u>**:

- **Spirochetes** (*spira* = a turn; *chaeta* = a hair) *E.g., Treponema sp.*
- **Narrow and regular spirals**

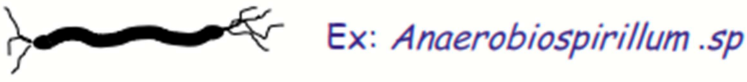


- **Wide and regular spirals**

- **Narrow and irregular spirals**



- **Very thick**



4. **Other atypical forms:**
    - Filamentous → *Actinomyces*
    - Pleomorphic (variable shapes : heterogeneous shape) → *Mycoplasma*
    - Star-shaped bacteria, for example, *Stella*

Branched bacilli

1.2. Sizes

- Expressed in micrometers (µm)
- Variable within the bacterial world.
- Generally between **0.1 and 10 µm**
- Cocci: 0.5 - 1.5 µm in diameter
- Bacilli: 1 - 10 µm in length and 0.2 - 1 µm in width
- The smallest: 0.1 - 0.2 µm (e.g., *Chlamydiales*)
- The largest known prokaryote: *Thiomargarita namibiensis* has a diameter of 100 - 750 µm.