

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

222 MICRO

**LAB 4 : BACTERIAL APPENDAGES
(2)**

Structures

1

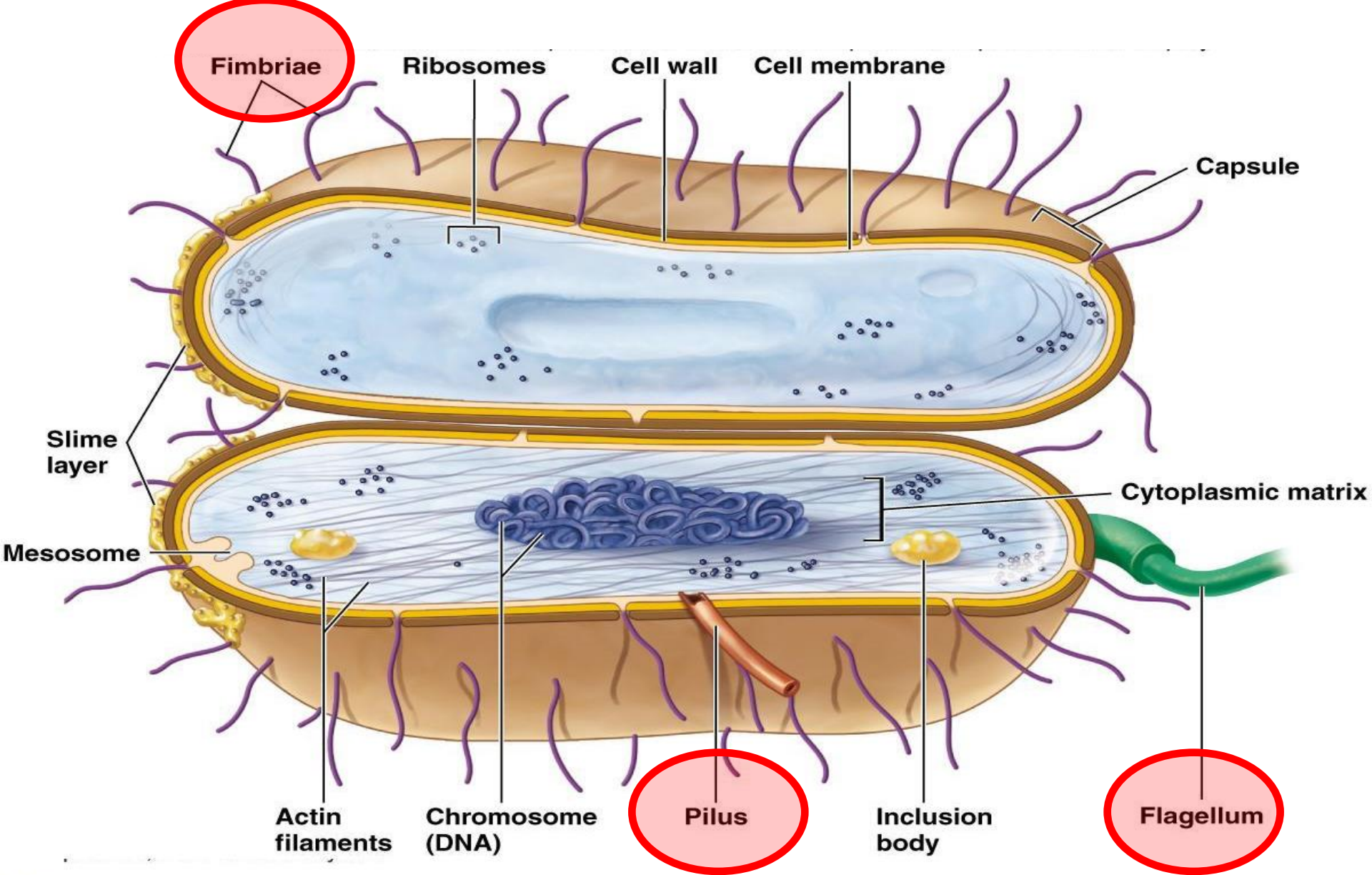
Capsule

2

-Pili
-Fimbriae
-Flagella

3

Endospores

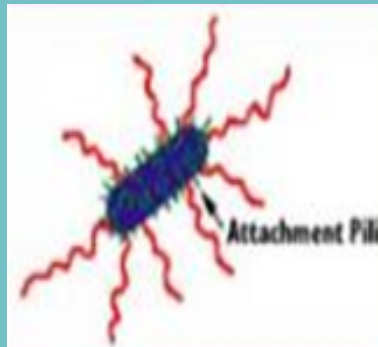


5 Cells secrete their enzymes in unison to digest food particles.

Bacterial Appendages

Pili

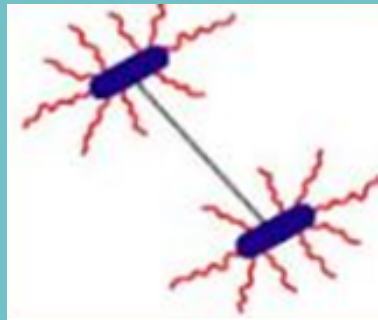
Pili , (pilus)

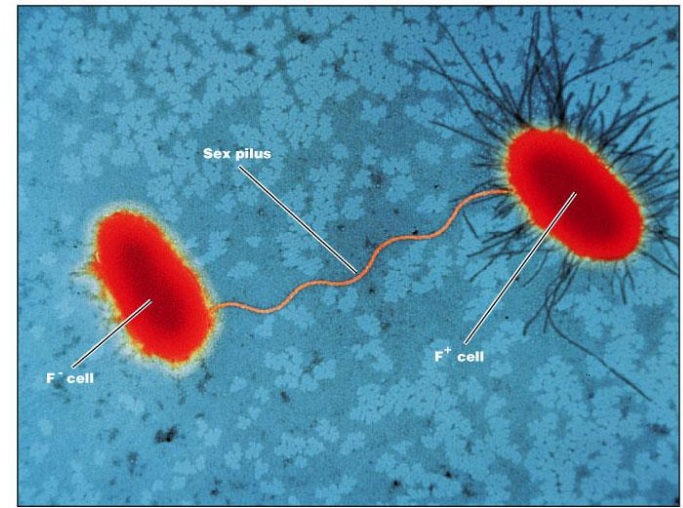


- ⊙ Only found in **gram negative** bacteria
- ⊙ Tubulare, hairlike structures of protein larger and more rare than fimbriae.

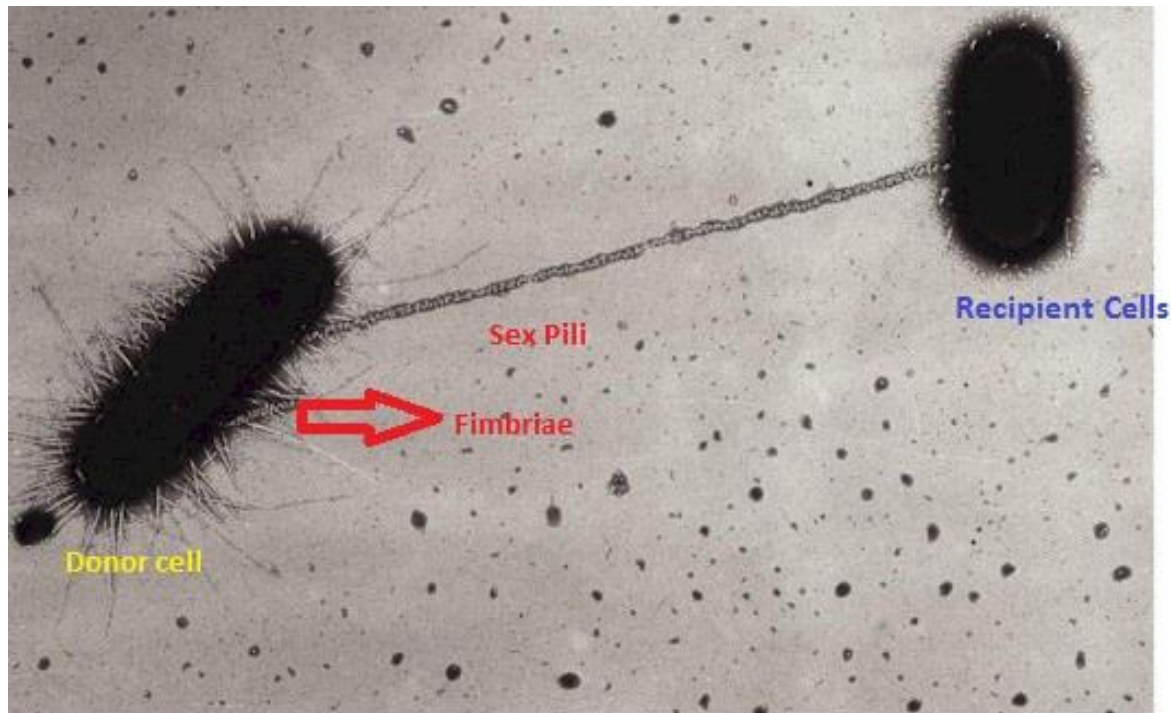
⊙ 2 types of pili :

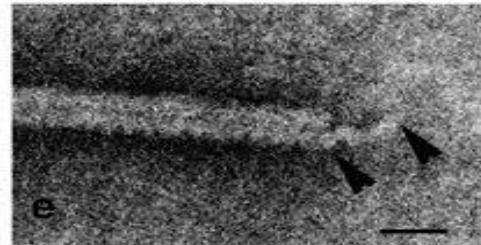
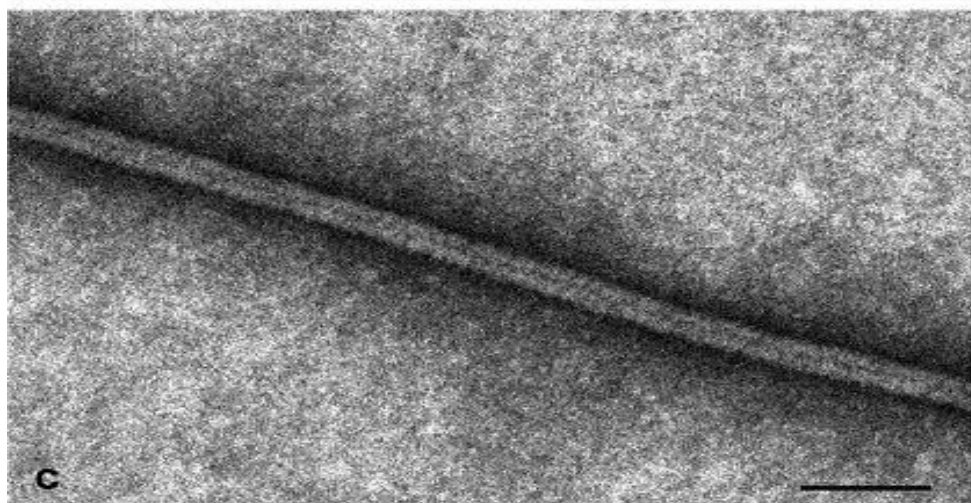
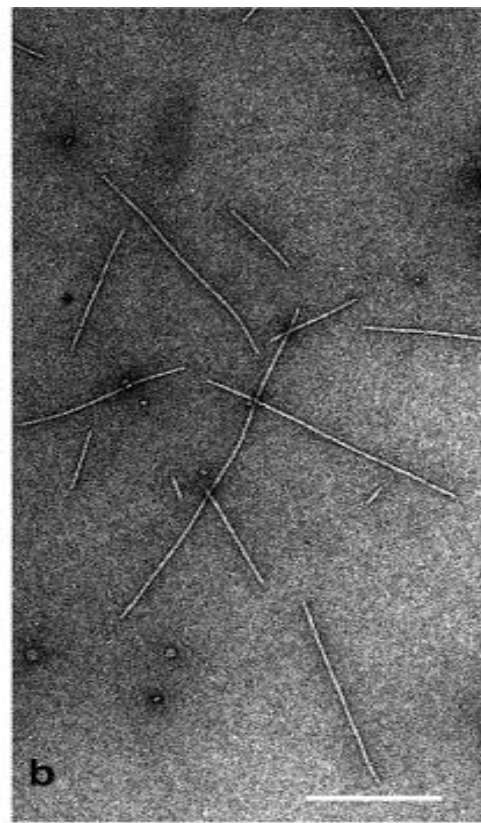
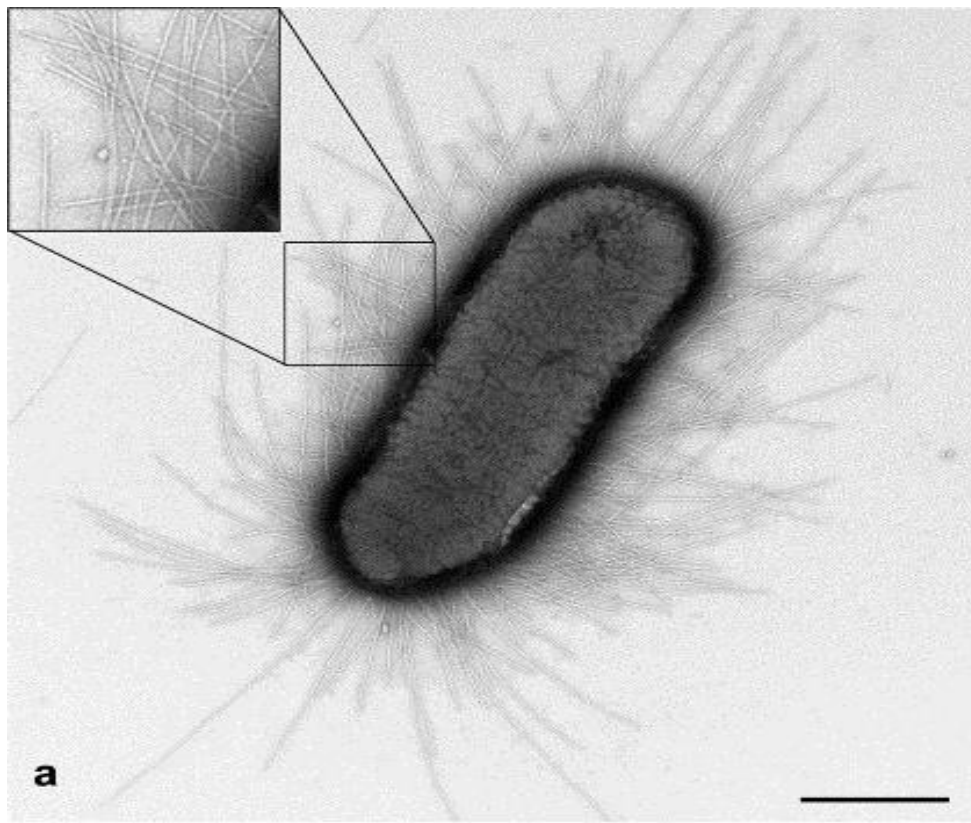
1. **Atachment pilus** - allow bacteria to attach to other cells
2. **Sex pilus**, - transfer from one bacterial cell to another, only 1-4 , conjugation.





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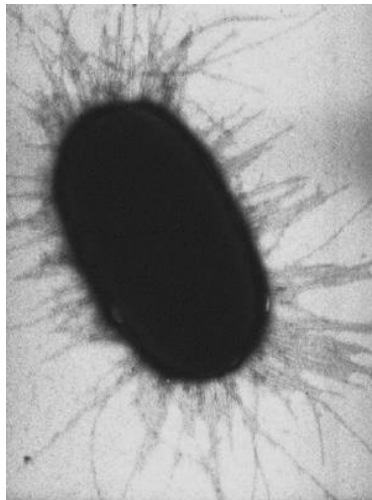


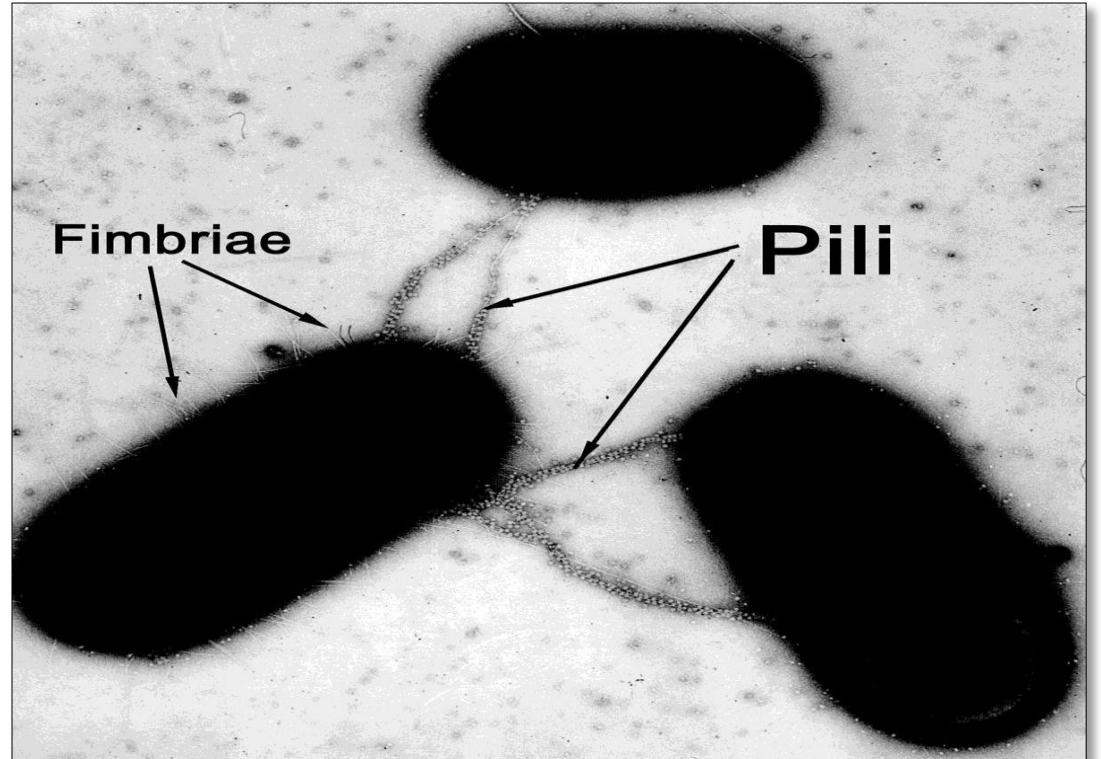
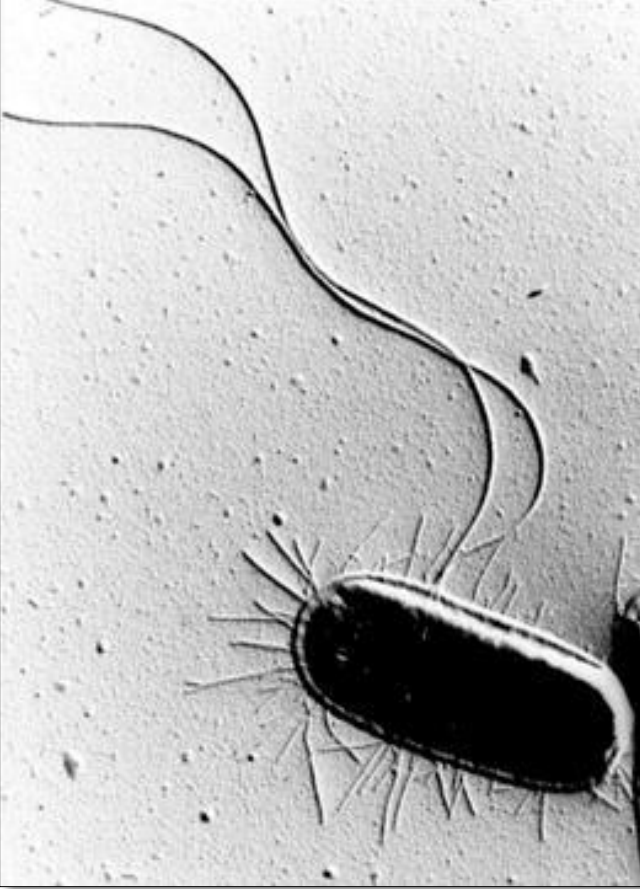
Bacterial Appendages

Fimbriae

Fimbriae

- ⊙ Fimbriae are very fine fibrillar structures.
- ⊙ Fimbriae help the bacteria to stick to surfaces.
- ⊙ e.g. *E.coli*





Bacterial Appendages

Flagella

Flagella

⊙ **Flagella :**

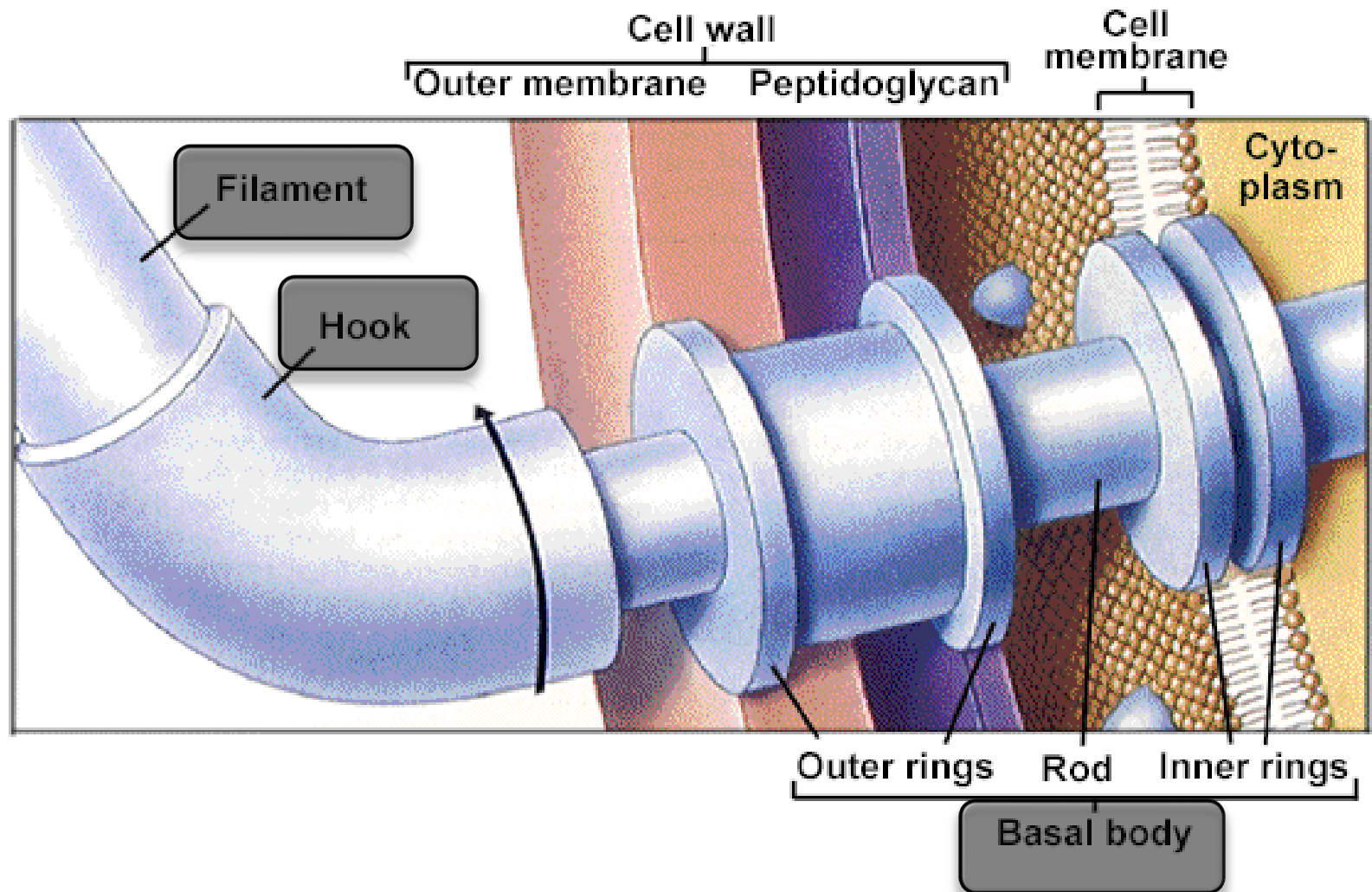
- ⊙ long appendages which rotate by means of a "motor" located just under the cytoplasmic membrane.
- ⊙ bacteria may have one, a few, or many flagella in different positions on the cell.

⊙ **Advantages:**

- Identification of Bacteria
- Pathogenesis
- Motility of bacteria

⊙ **All spirilla, half of bacilli, rare cocci.**

Structure of flagella



Structure of flagella

Three morphological regions :

1. Helical filament

- ⊙ contains the protein (flagellin) arranged in several chains.

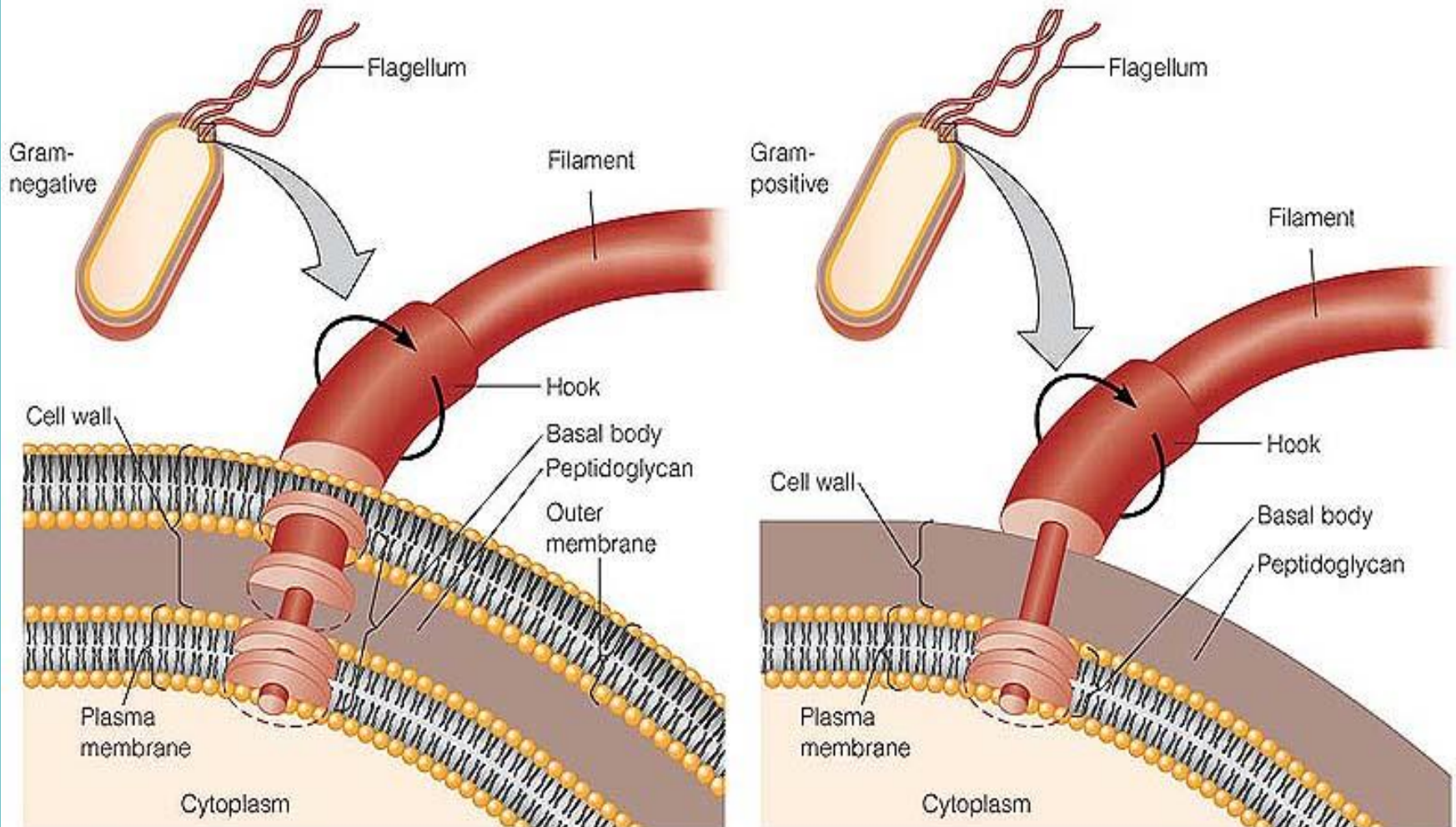
2. Hooked or curved area

- ⊙ Consists of a different protein.

3. Basal body

- ⊙ Terminal portion of the flagellum
- ⊙ Fix the flagellum to the cell wall and plasma membrane
- ⊙ Composed of a central rod inserted into a series of rings

Flagella in gram **negative** and **positive** bacteria



(a) Parts and attachment of a flagellum of a gram-negative bacterium


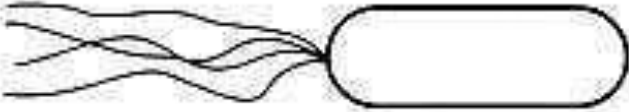

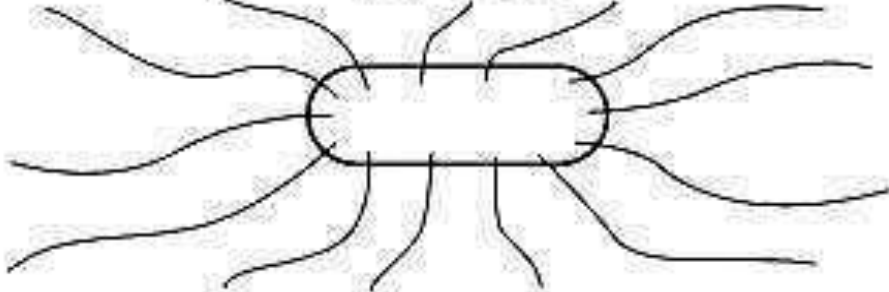
(b) Parts and attachment of a flagellum of a gram-positive bacterium



Flagella in gram **negative** and **positive** bacteria

- ◎ **Gram negative - 2 pairs of rings :**
 - **Outer pair** - fixed to the outer membrane and peptidoglycan layer
 - **Inner pair** - fixed to the plasma membrane
- ◎ **Gram positive - only inner pair is present**

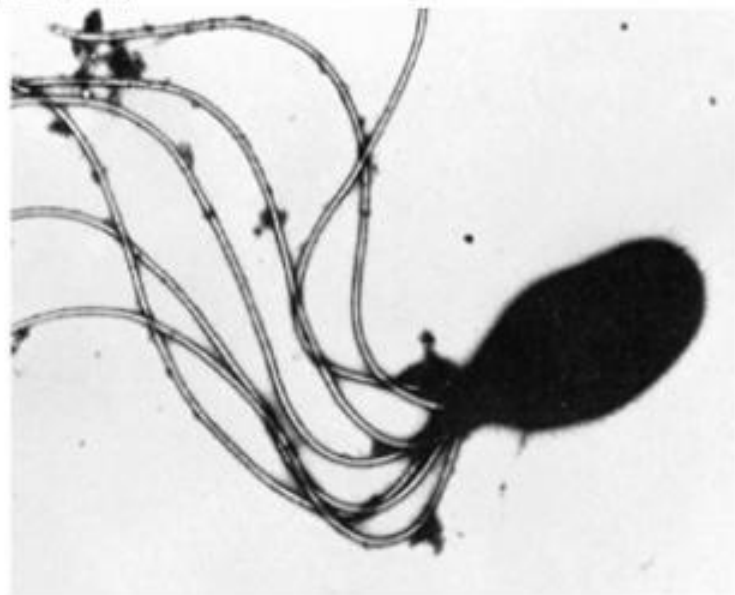
Arrangement

Structure	Flagella Type	Example
	Monotrichous	<i>Vibrio cholerae</i>
	Lophotrichous	<i>Bartonella bacilliformis</i>
	Amphitrichous	<i>Spirillum serpens</i>
	Peritrichous	<i>Escherichia coli</i>



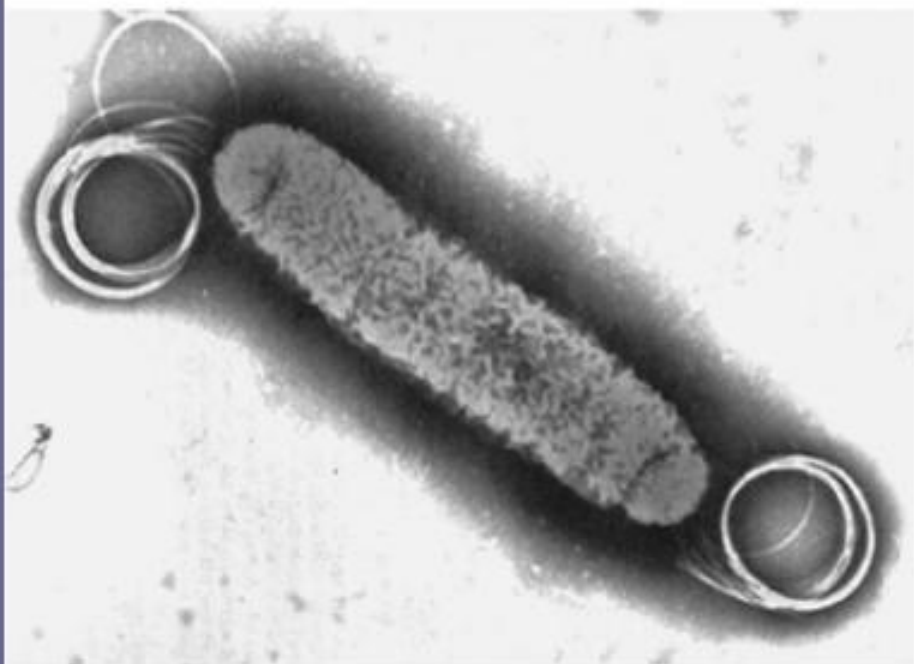
(a)

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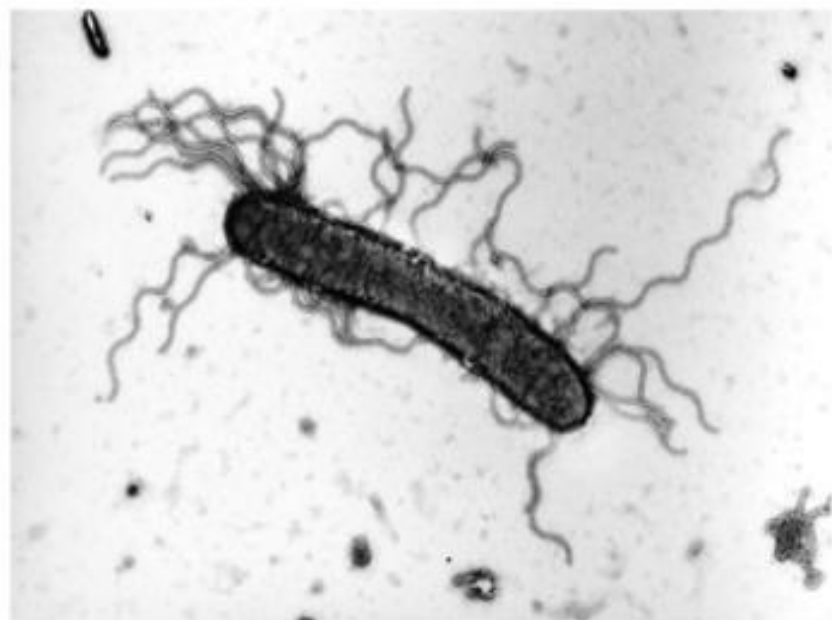
(b)

© From Racheli and Baumann, Arch. Microbiol. 94:283-330, © Springer-Verlag, 1973



(c)

© From Noel R. Krog in Bacteriological Reviews, March 1976, Vol. 40(1):67 fig. 7



(d)

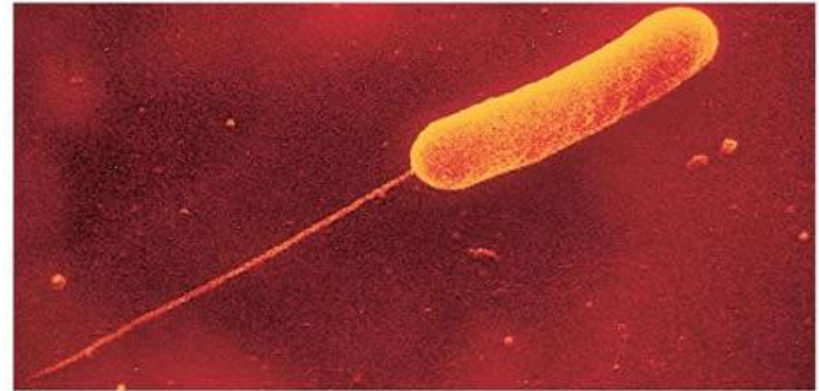
© From Preez et al., Bacteriological Review, June 1974, 38(2), 121, fig 7 © ASM

Arrangement



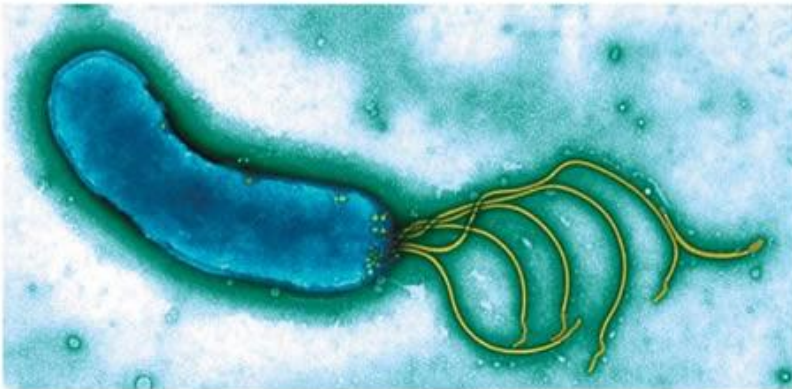
(a) Peritrichous

SEM | 0.5 μm



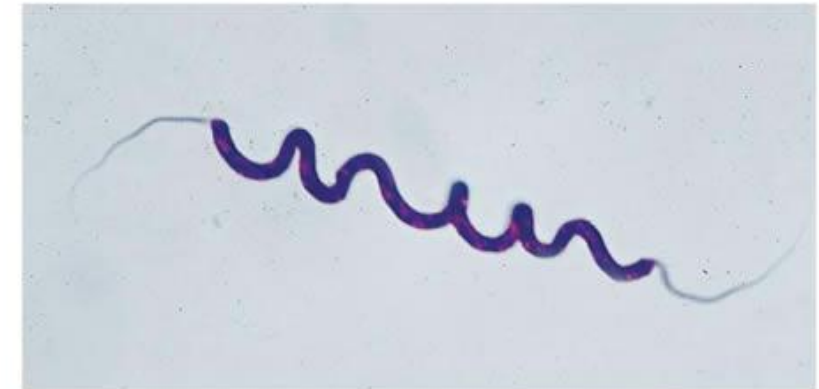
(b) Monotrichous and polar

SEM | 0.5 μm



(c) Lophotrichous and polar

SEM | 0.5 μm



(d) Amphitrichous and polar

SEM | 5 μm



Motility



Evidence of motility

Two ways by which motility can be demonstrated:

1- direct or microscopic

- hanging drop preparation by dark field microscope

Distinguishes:

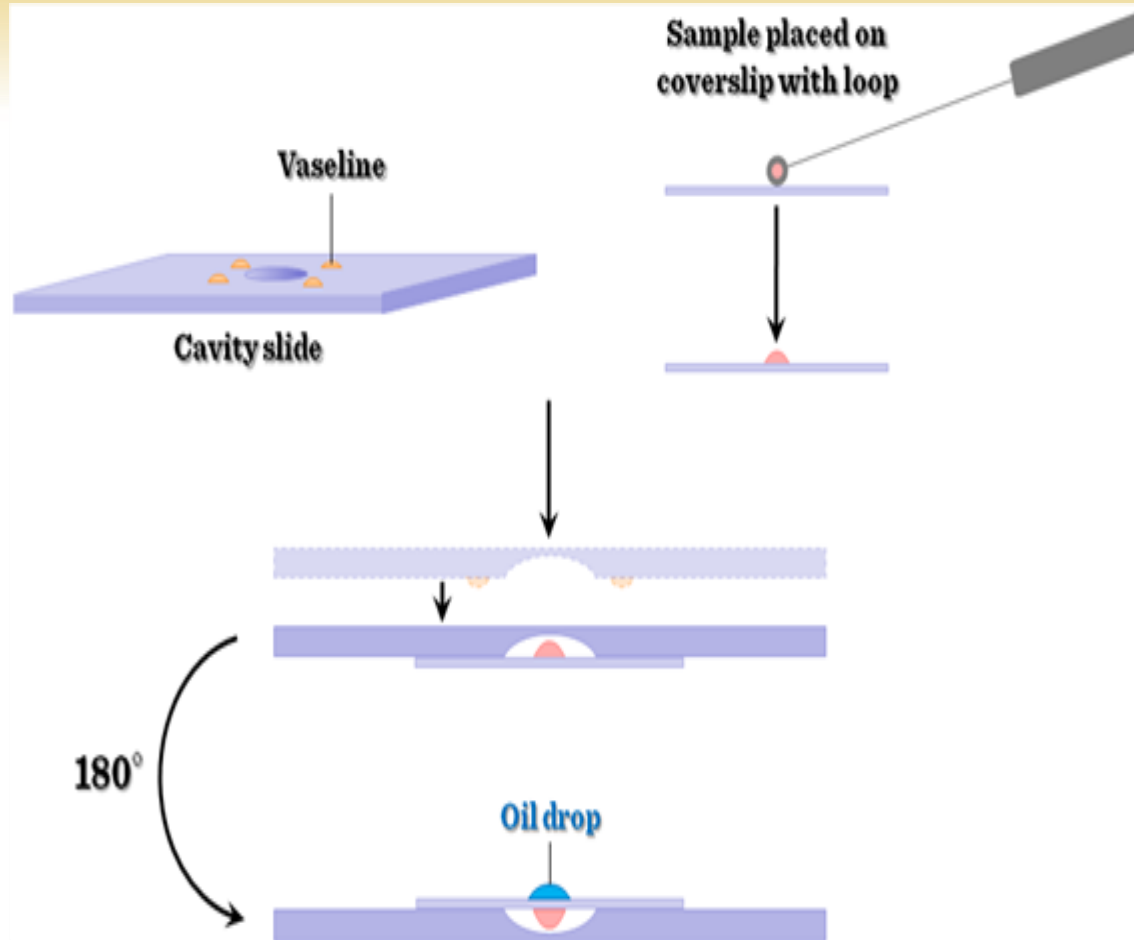
- **Brownian movement** - when the bacteria show molecular movement
- **True motility** - if a bacterium describes a rotatory, undulatory or sinuous movement

2- indirect or macroscopic :

Stab inoculation of the semisolid media

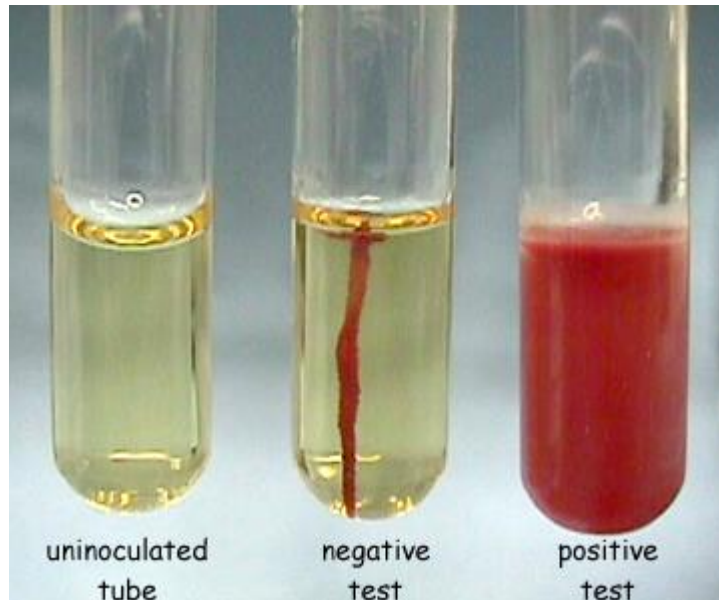
- **non motile** - growth is limited at the point of inoculation
- **motile** - growth is diffuse or moves away from the line of inoculation; turbidity of the medium

- Direct



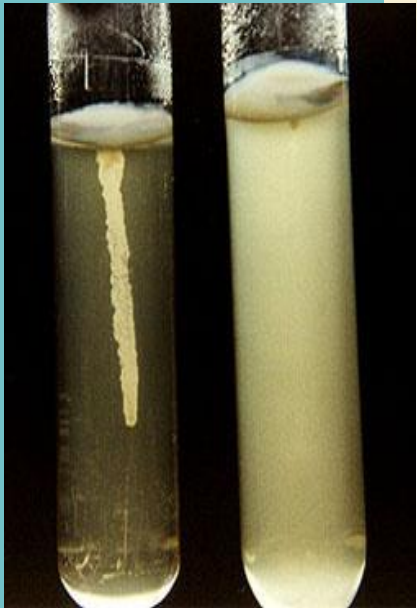
Motility test medium

- Indirect



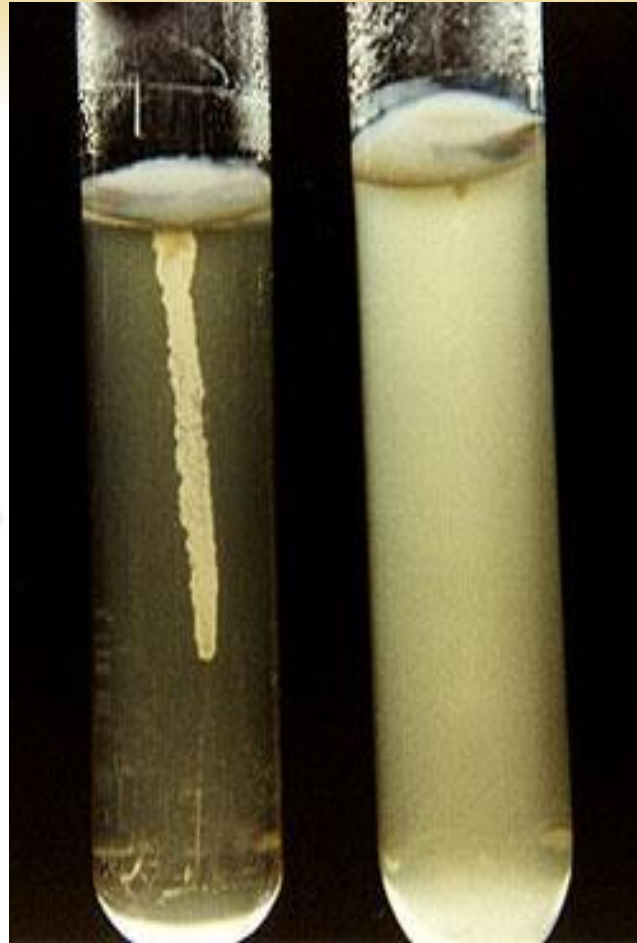
Motility test medium

- ⊙ Bacterial cells can swim in a semisolid medium.
- ⊙ A semisolid medium such as 0.75% agar is inoculated with the bacteria in a straight-line stab with a needle.
- ⊙ After incubation, if turbidity (cloudiness) due to bacterial growth can be observed away from the line of the stab.



**Bacterial cultures grown in motility test medium.
The tube on left is a non motile organism; the tube
on right is a motile organism.**

**non motile
organism**



**motile
organism**

Bacterial Motility Test

Motile bacteria

Non-Motile bacteria



Diffuse growth



Localized growth