

# 222 MBIO

## Microbial Fine Structure

Dr. Aljawharah Fahad Alabbad

Dr. Haya Mohammed Aldosari

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# Bacterial Appendages

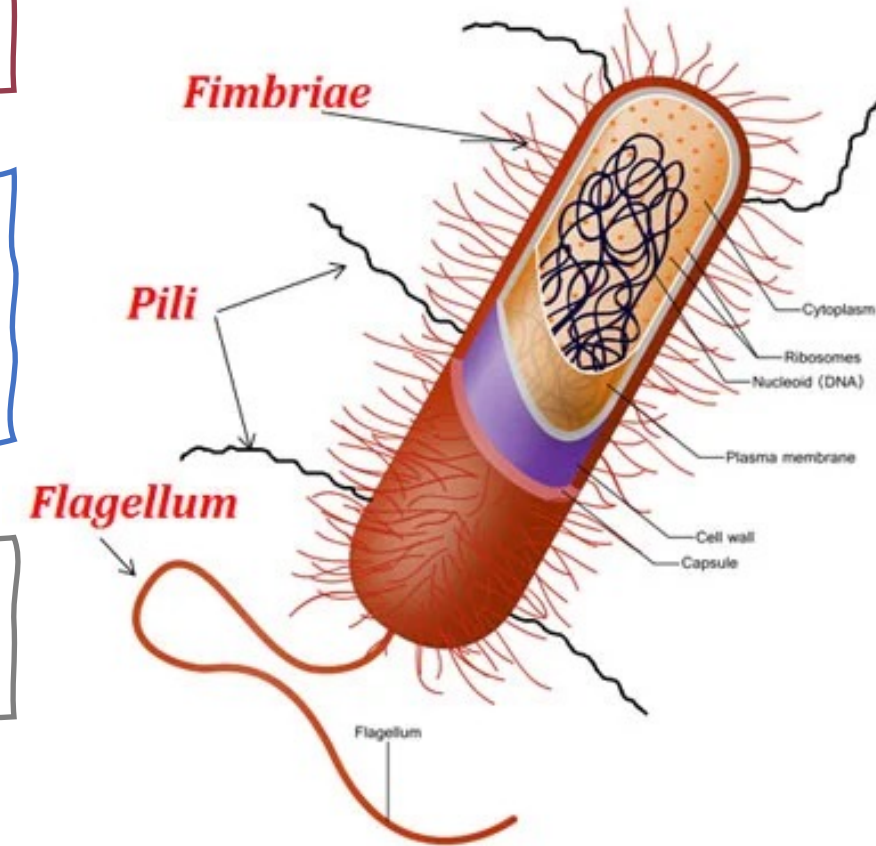
- Lab 4 -

# (Particular /Accessory) Structures

**Capsule**

**Flagella, Pili, Fimbriae** → They can be visualized by using only an electron microscope

**Endospores**



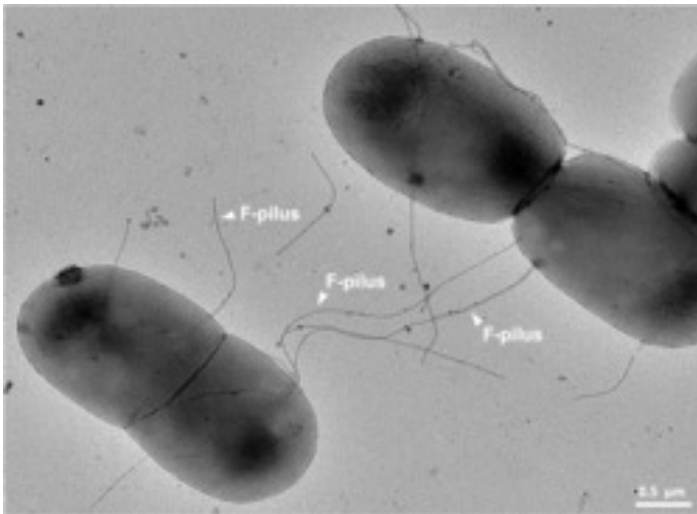
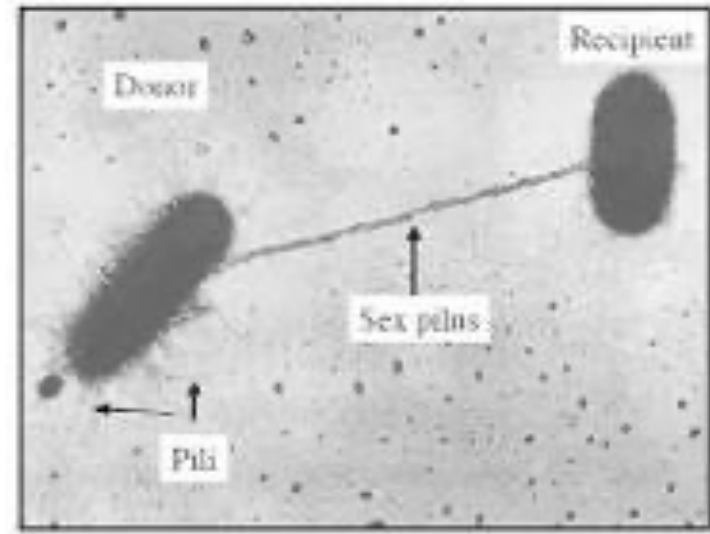
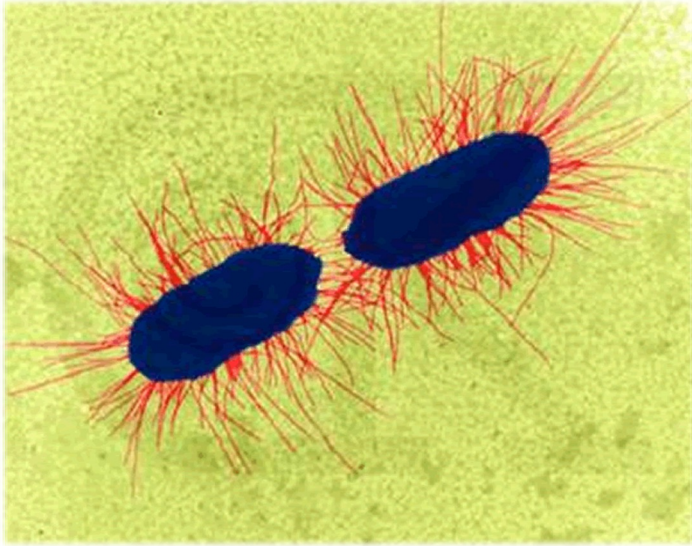
# First: Pili

- Singular → **Pilus**.
- Hair-like cell-surface appendage.
- Found mainly in **Gram-negative** organisms.
- Primarily **composed** of **pilin protein**.
- Generally, there are **two main types of pili**:
  1. **Attachment pilus** (Adhesive pilus).
  2. **Conjugative pili**.

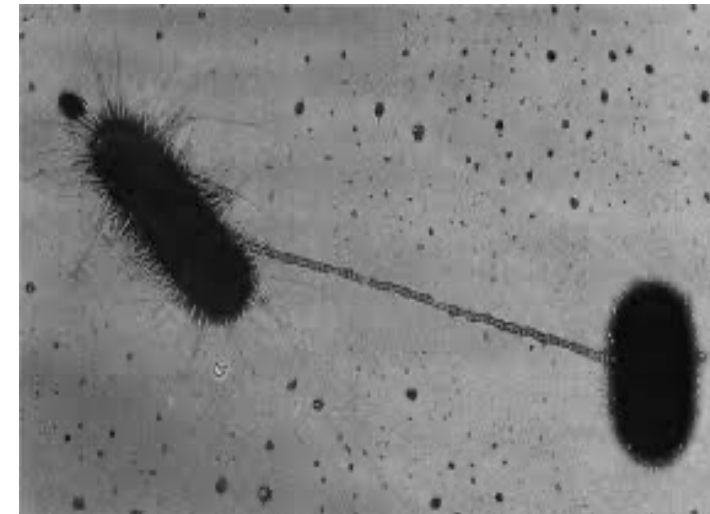
## Attachment pilus

## Conjugative pili

<b>Function</b>	<ul style="list-style-type: none"><li>- Mediate the <b>attachment</b> of bacteria to <u>specific receptors</u> on the human cell surface, which is the <u>first step</u> in establishing <b>infection</b> in some organisms.</li></ul>	<ul style="list-style-type: none"><li>- Also called sex pili.</li><li>- Allows for the <b>transfer of DNA</b> between bacteria (Donor and recipient), in the process of <b>bacterial conjugation</b>.</li></ul>
<b>Description</b>	<ul style="list-style-type: none"><li>- <b>Shorter</b> and <u>more numerous</u></li></ul>	<ul style="list-style-type: none"><li>- <b>Longer</b> and <u>fewer in number</u></li></ul>
<b>Features</b>	<ul style="list-style-type: none"><li>- Contribute to the <b>pathogenicity</b> of certain bacteria by enhancing <u>colonization</u> on the <u>surfaces</u> of the cells of other organisms.</li></ul>	<ul style="list-style-type: none"><li>- This process is well characterized in the <b>gram-negative</b> bacillus <u><i>Escherichia coli</i></u>.</li></ul>



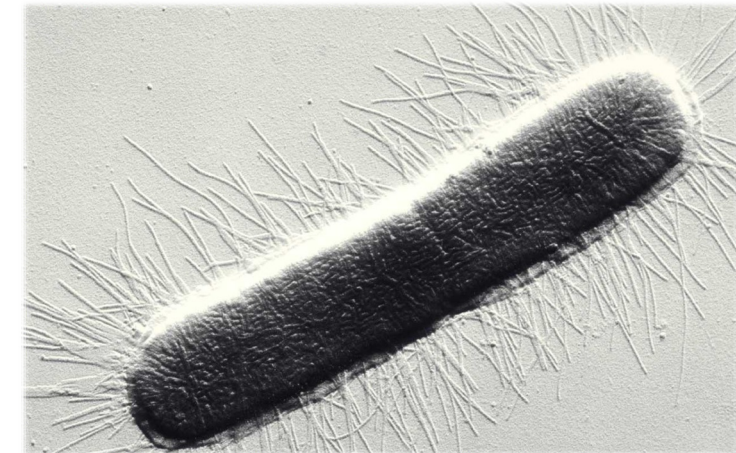
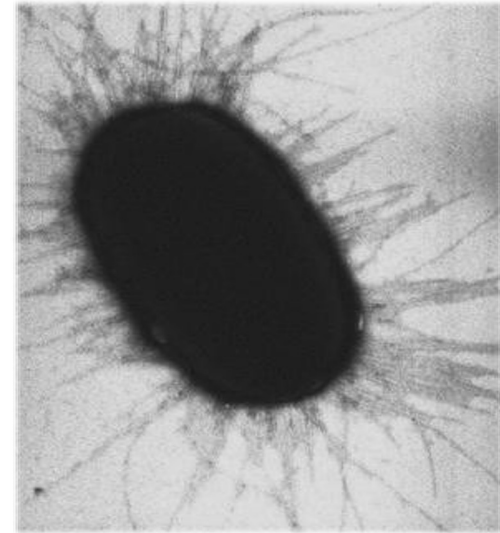
**Attachment pilus**



**Conjugative pili**

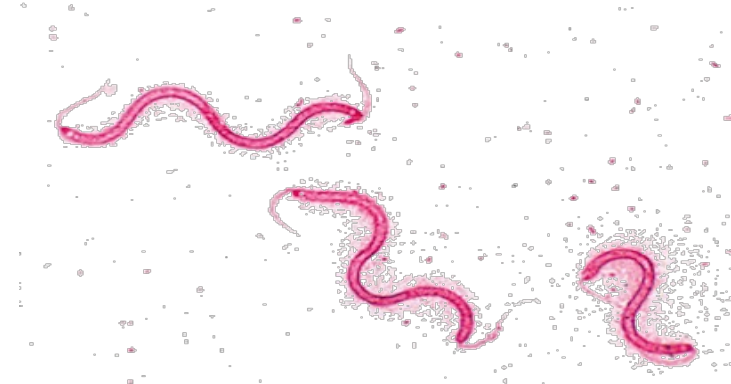
# Second: Fimbriae

- Fimbriae are **short, thin, hair-like appendages** that are more numerous than pili, typically numbering around 200–400 per bacterial cell.
- They are commonly found in **Gram-negative bacteria**.
- Fimbriae play a vital role in **bacterial adhesion to surfaces**, including host tissues, which is a key step in colonization and the establishment of infection.



# Third: Flagella

- Bacterial flagella are **long, thread-like structures** attached to some bacteria that **help them move through liquid** by rotating like a tiny motor.
- Functions:
  1. **Motility**
  2. **Characterization** of bacteria
  3. **Pathogenesis:** Flagella act as a virulence factor that helps in the **adhesion** of the bacterial cell to the host cell



# The Structure of Flagella

## 1. Filament

- The long, whip-like part that extends out from the surface of the bacterium.

**Made entirely of flagellin protein.**

## 2. Hook

- It connects the filament to the base of the flagellum.

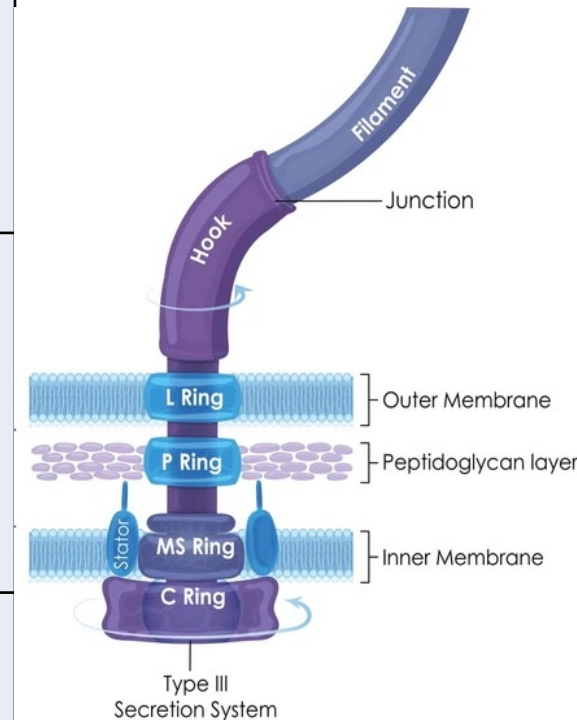
It **works like a flexible joint, allowing the filament to rotate at different angles.**

## 3. Basal body

- The **motor** part of the flagellum.

- It is embedded in the cell envelope.

- It contains several rings and a rod that work together to **spin the flagellum.**



# The Arrangement of Flagella

## Monotrichous

- One single flagellum at one end
- E.g., *Vibrio cholerae*



## Lophotrichous

- A cluster of flagella at one end
- E.g., *Pseudomonas marginalis*



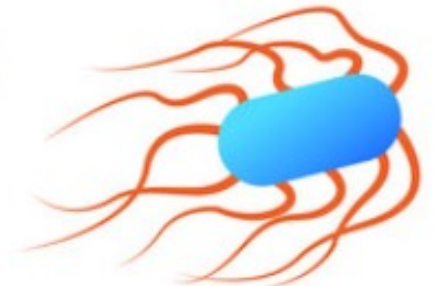
## Amphitrichous

- One flagellum at each end of the cell
- E.g., *Spirillum volutans*



## Peritrichous

- Flagella all over the surface of the bacterium
- E.g., *E. coli*, *Salmonella Typhi*





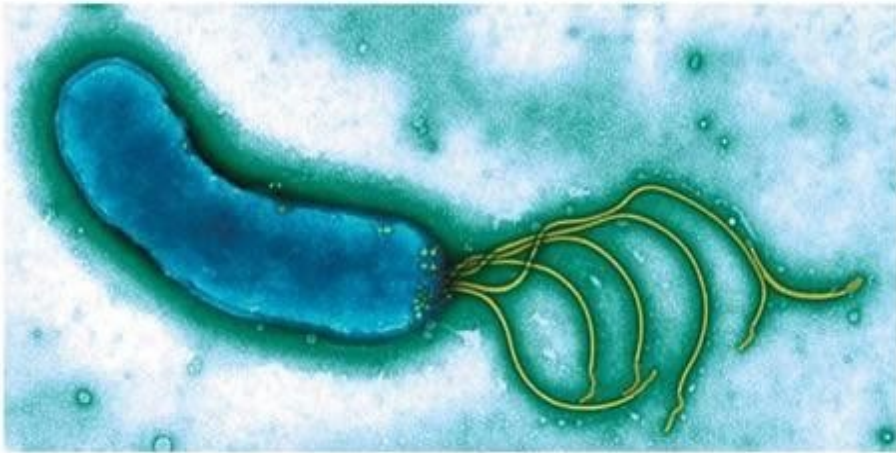
**(a) Peritrichous**

SEM | 0.5  $\mu\text{m}$



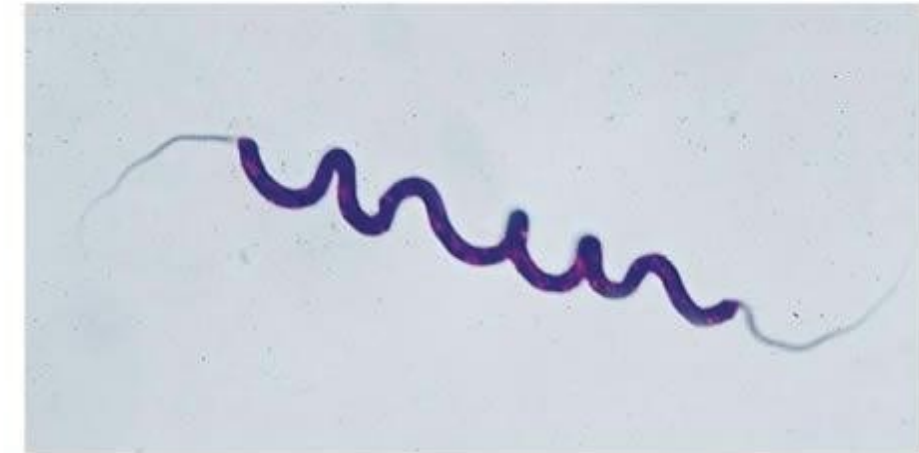
**(b) Monotrichous and polar**

SEM | 0.5  $\mu\text{m}$



**(c) Lophotrichous and polar**

SEM | 0.5  $\mu\text{m}$



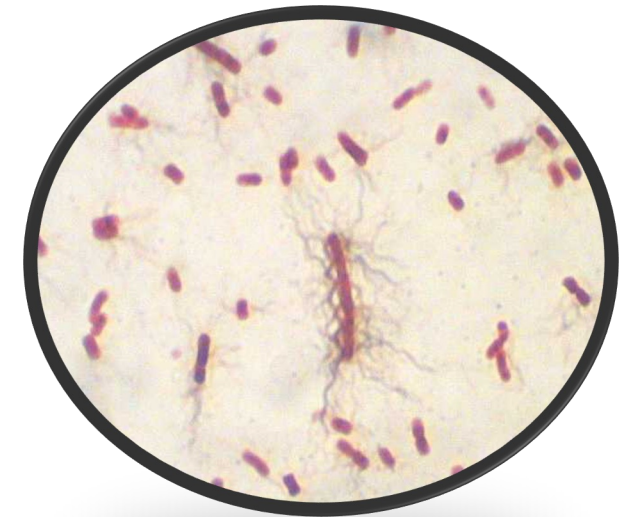
**(d) Amphitrichous and polar**

SEM | 5  $\mu\text{m}$

# Bacterial Motility

# Introduction

- Motility is the **ability of an organism to move** by itself using propeller-like flagella unique to bacteria or by special fibrils that produce a **gliding form of motility**.
- The aim of the experiment is to:
  1. Determine the motility of the bacterium.
  2. Differentiate between motile and nonmotile bacteria.



# Two ways by which motility can be demonstrated:

## 1- Direct or microscopic

### Hanging drop

#### a) Brownian movement

- Random movement
- Occurs due to collisions with other molecules.

#### b) True motility

- Self-propelled movement of bacteria

## 2- Indirect or macroscopic

### Stab inoculation of the semisolid media

#### a) Non-motile

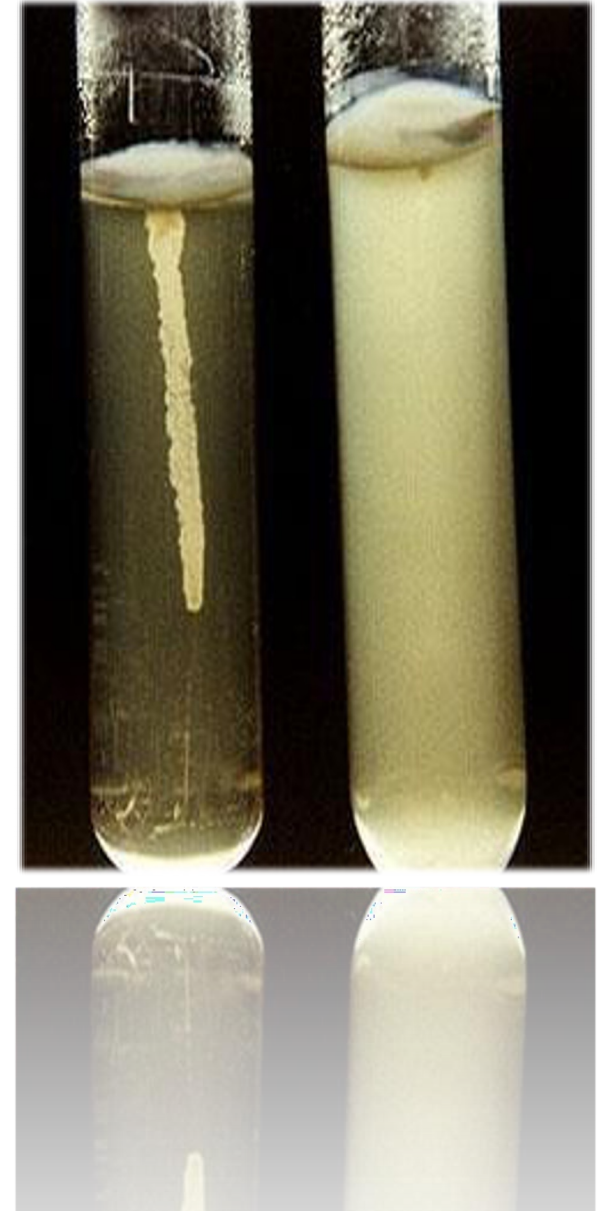
- Growth is limited at the point of inoculation

#### b) Motile

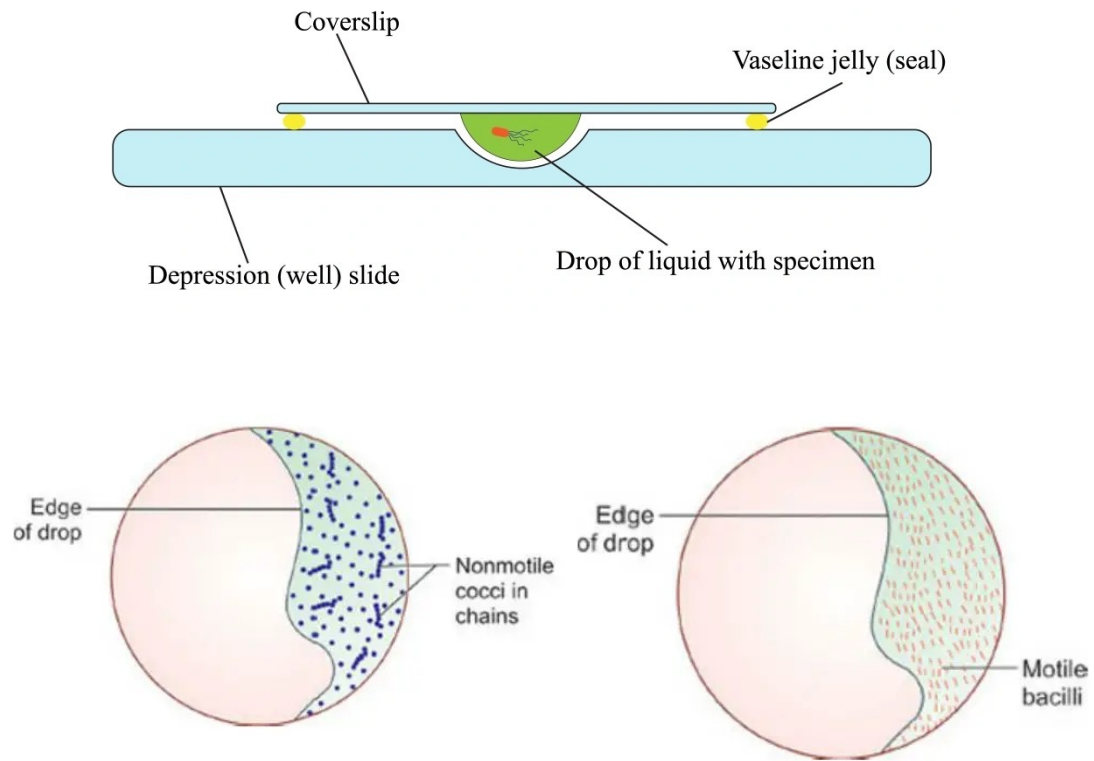
- Growth is diffuse or moves away from the line of inoculation; turbidity of the medium

# MOTILITY TEST MEDIUM

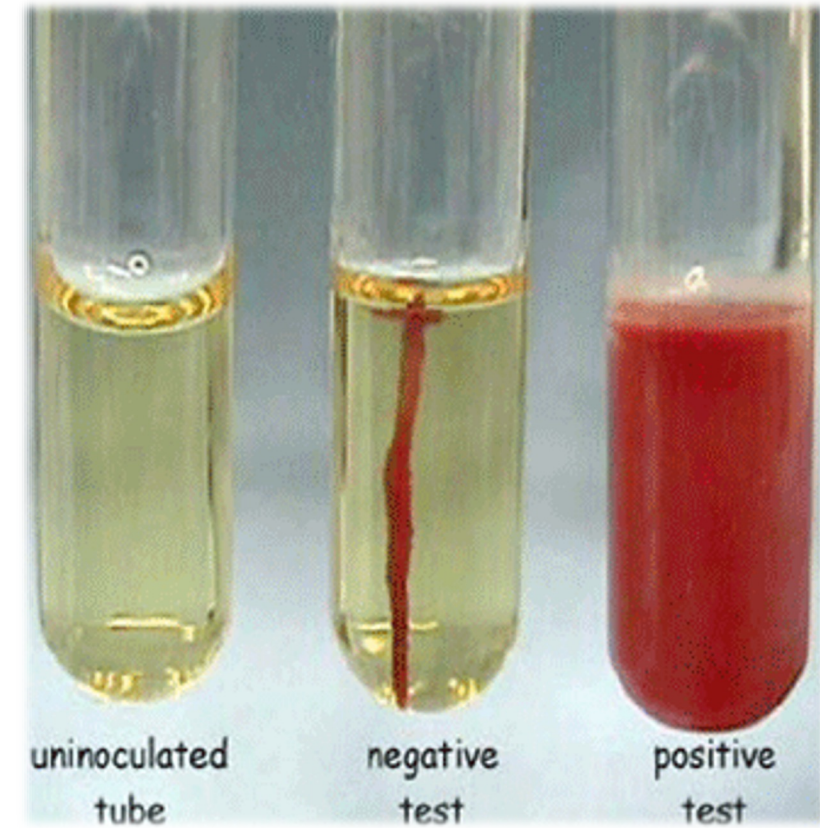
- ⦿ Bacterial cells can swim in a semisolid medium.
- ⦿ A semisolid medium is inoculated with the bacteria in a straight-line stab with a needle.
- ⦿ After incubation, if turbidity (cloudiness) due to bacterial growth can be observed away from the line of the stab.



# Direct

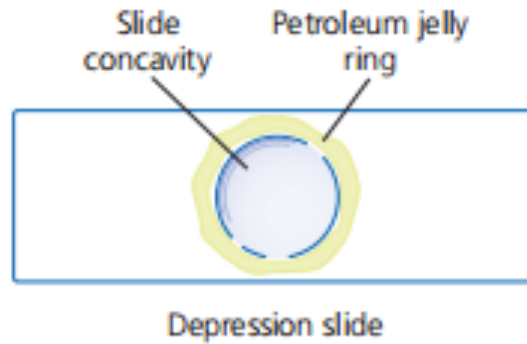


# Indirect

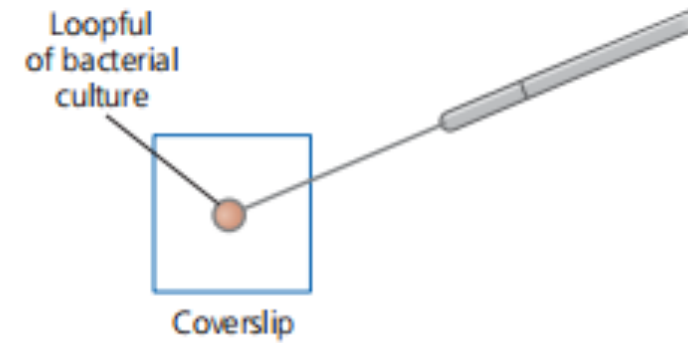


# Experiment 3: Investigating Bacterial Motility

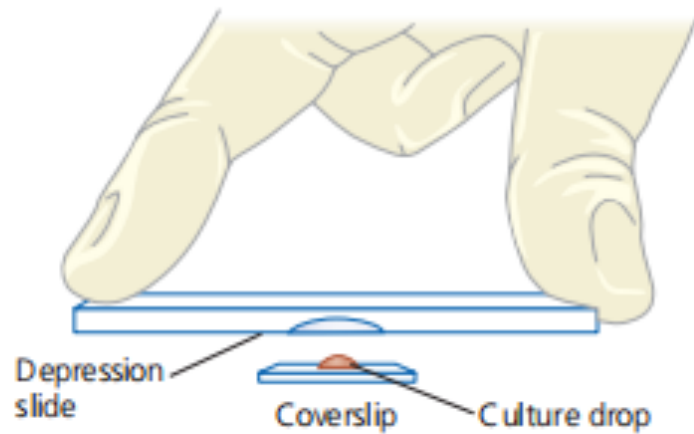
## PROCEDURE



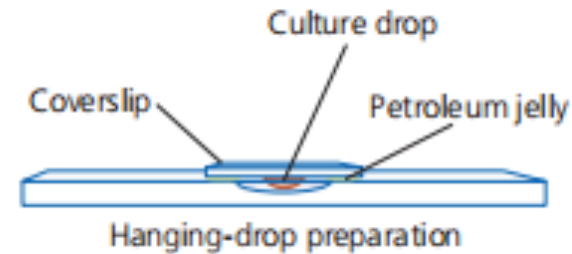
- 1 Spread a ring of petroleum jelly around the concavity of the depression slide.



- 2 Place a loopful of the bacterial culture in the center of the coverslip.



- 3 Lower the depression slide, with the concavity facing down, onto the coverslip. Press gently to form a seal.



- 4 Turn the hanging-drop preparation over so that the culture drop adheres to the coverslip.

# ❖ Results



“Success in this course comes from practice, attention to detail, and responsibility in the laboratory. Engage actively and make the most of every practical session.”

End of the Lab 🧐