# Water Microbiology

## For Ro Plants

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**Microbiologist**

# Agenda

This Presentation will cover :

- Introduction To Microbiology
- Microbial Indicators.
- Reverse Osmosis Microbiology Problems
- Water Microbiology Methods

# Microbiology definition

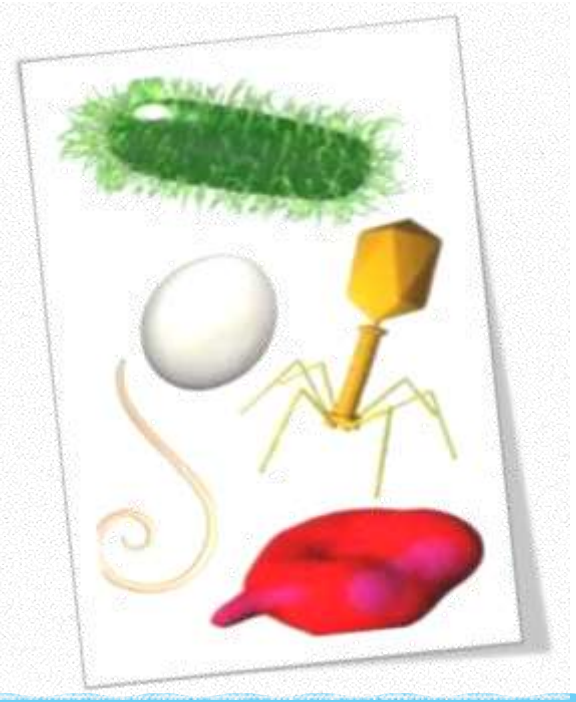
# Microorganisms – Found in almost all environments



Microorganisms

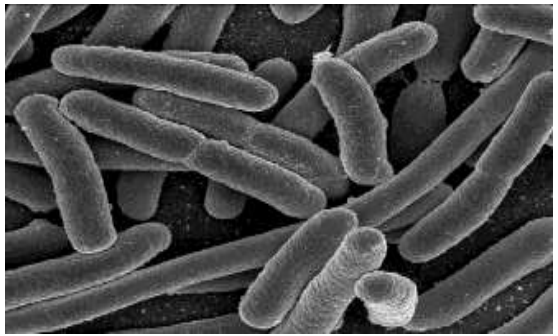
# Microbiology definition

## Micro + biology

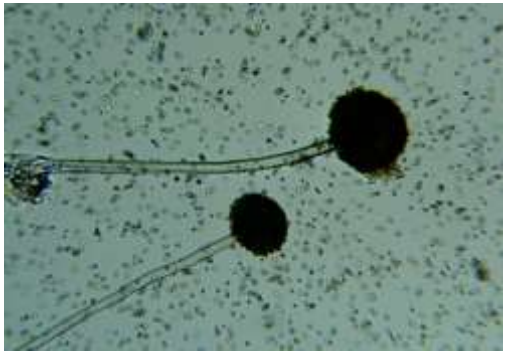


# Microbiology includes study of

Viruses

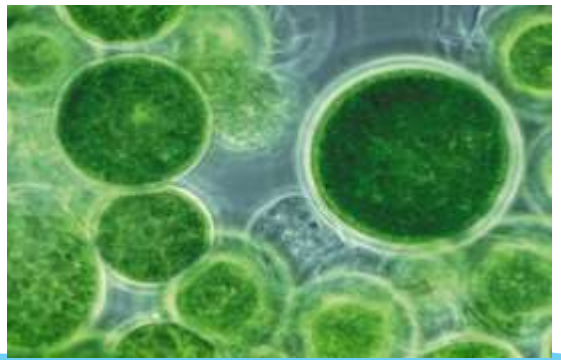


Bacteria



Fungi

Protozoa

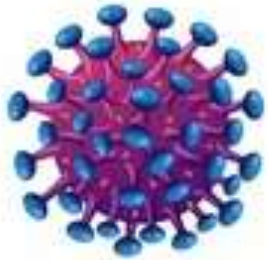


Algae


# WORKSHOP

*Microbiology Classification .. In 5 Minutes*

# Viruses

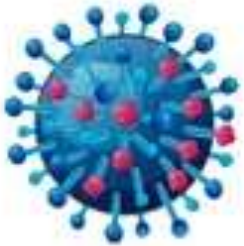


HIV

Hepatitis B

Ebola Virus

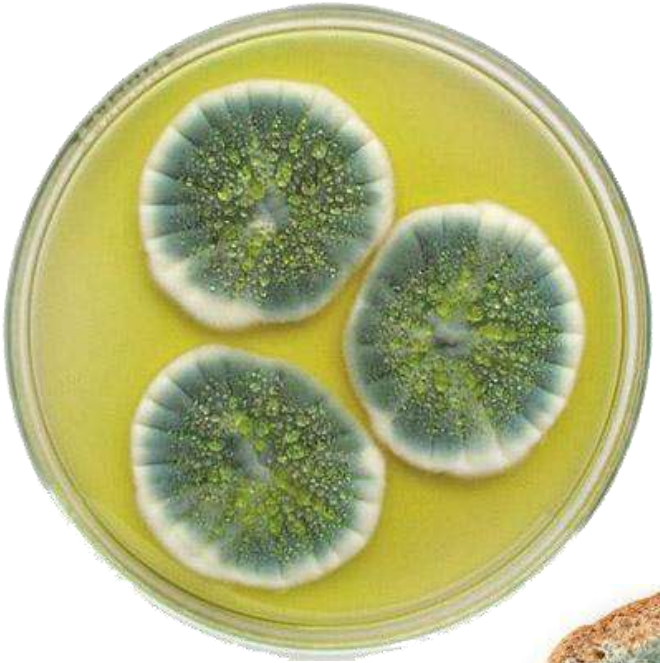
Adenovirus



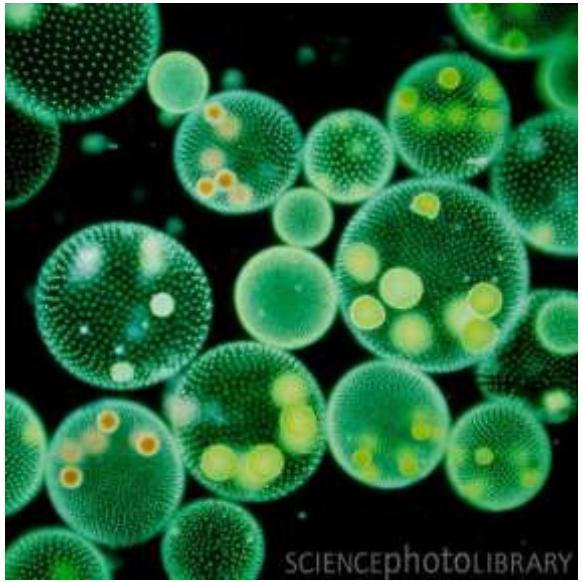
Influenza

Bacteriophage

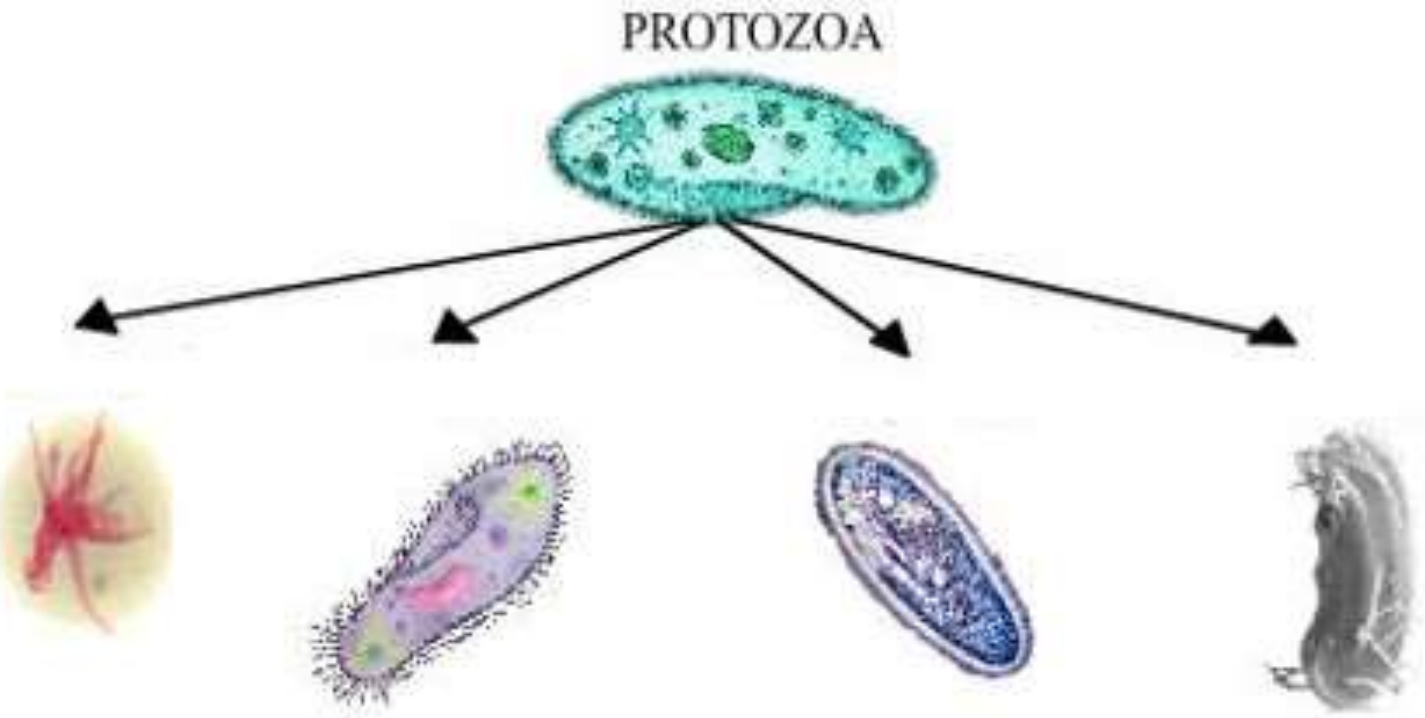
# Fungi



# Algae

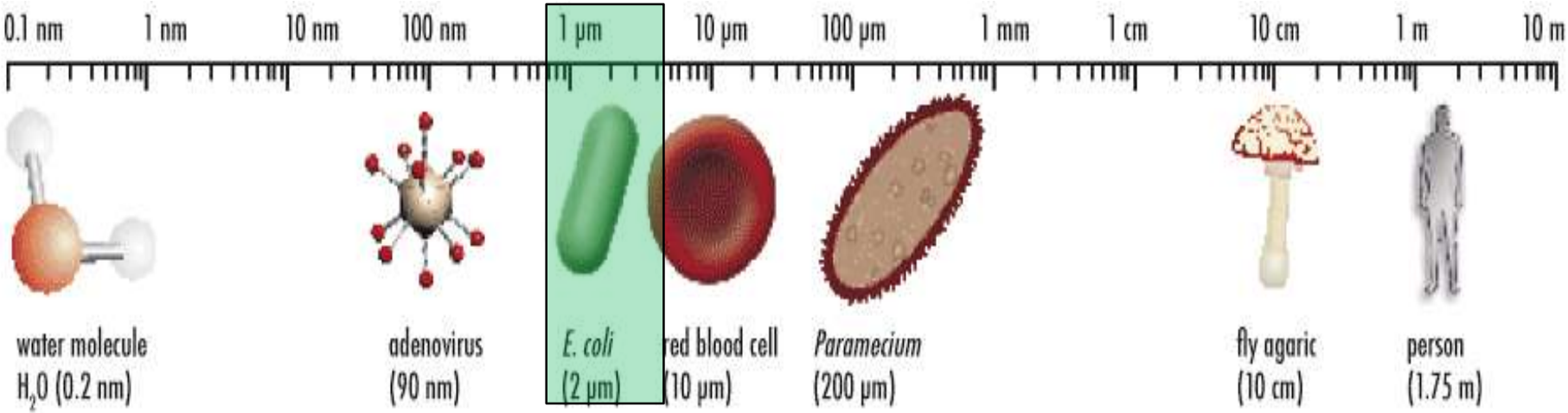



# Protozoa



# What Is Bacteria ?

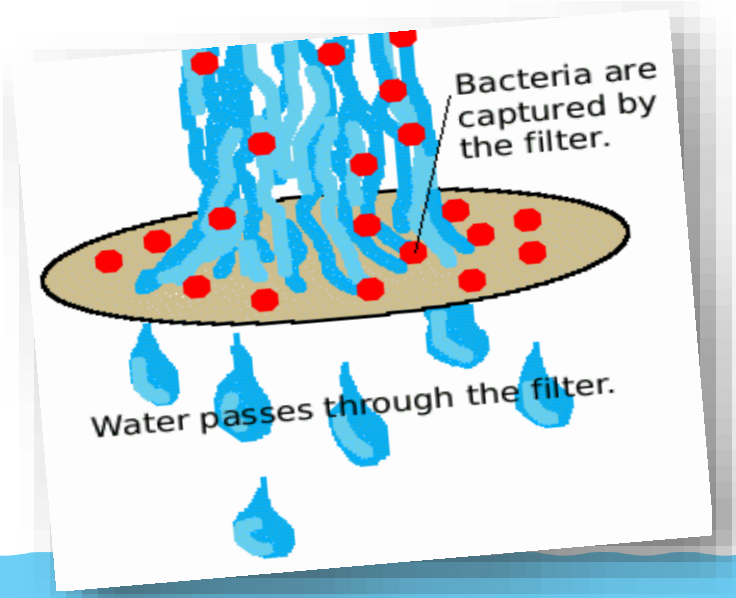
# Size of  Bacteria :

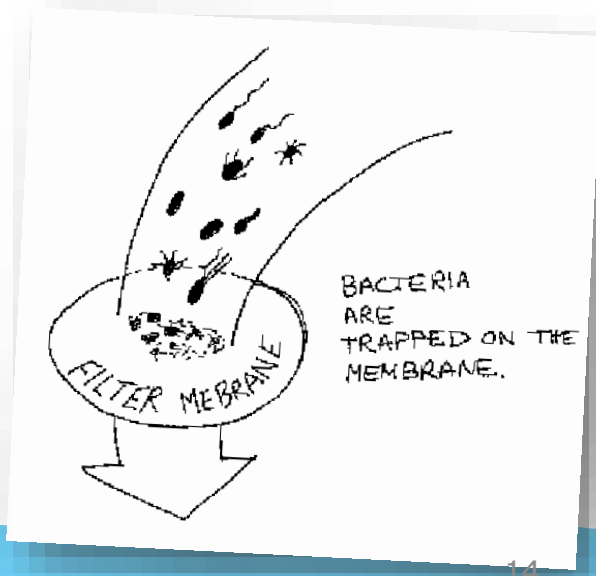


# Size of  Bacteria :

**Membrane Filter technique :**

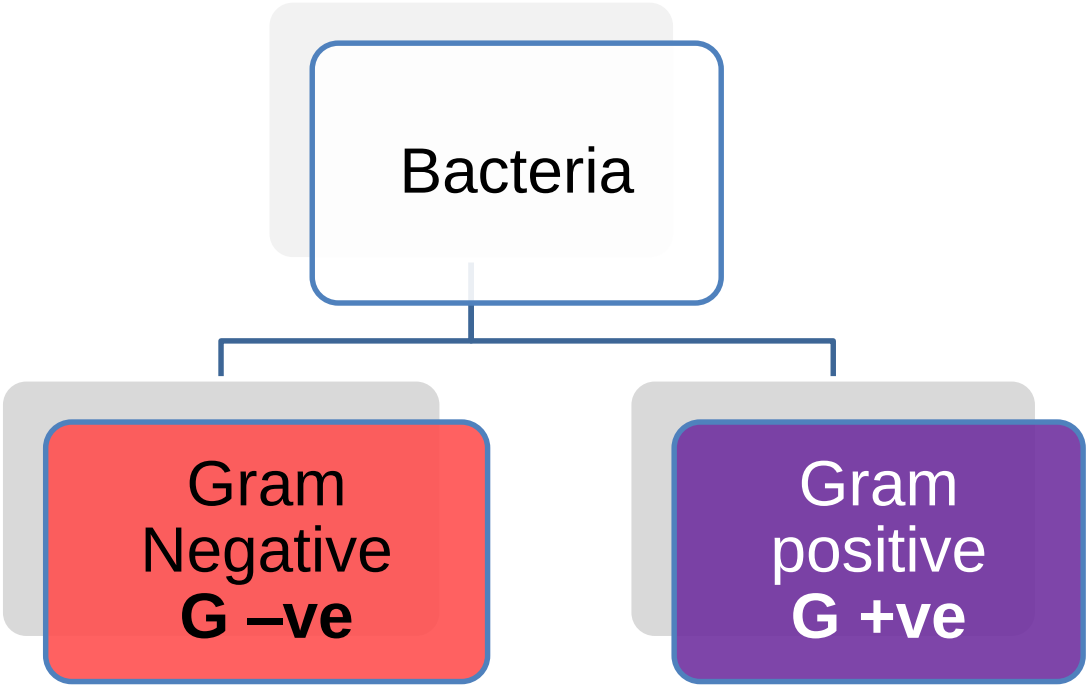
is depends on sample filtration through a 0.47-mm, **0.45µm pore size** cellulose membrane filters that retains the bacteria present in the sample.



# Classification of Bacteria (Gram stain)

# Gram stain



# Gram Stain

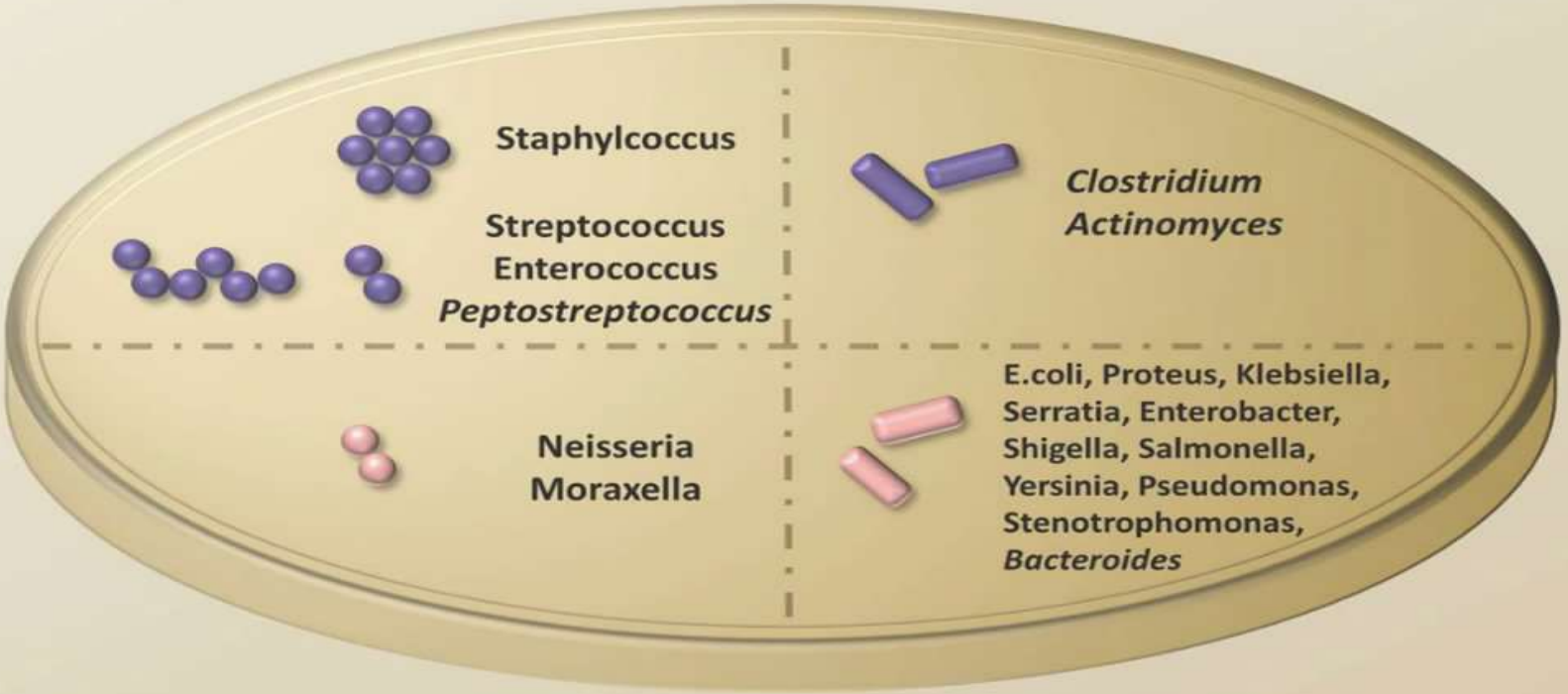
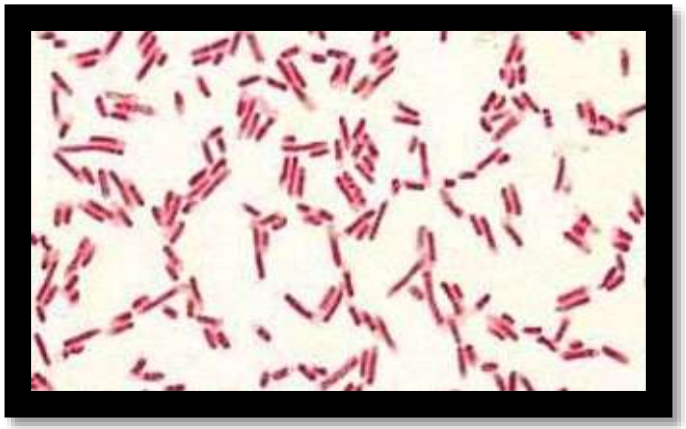
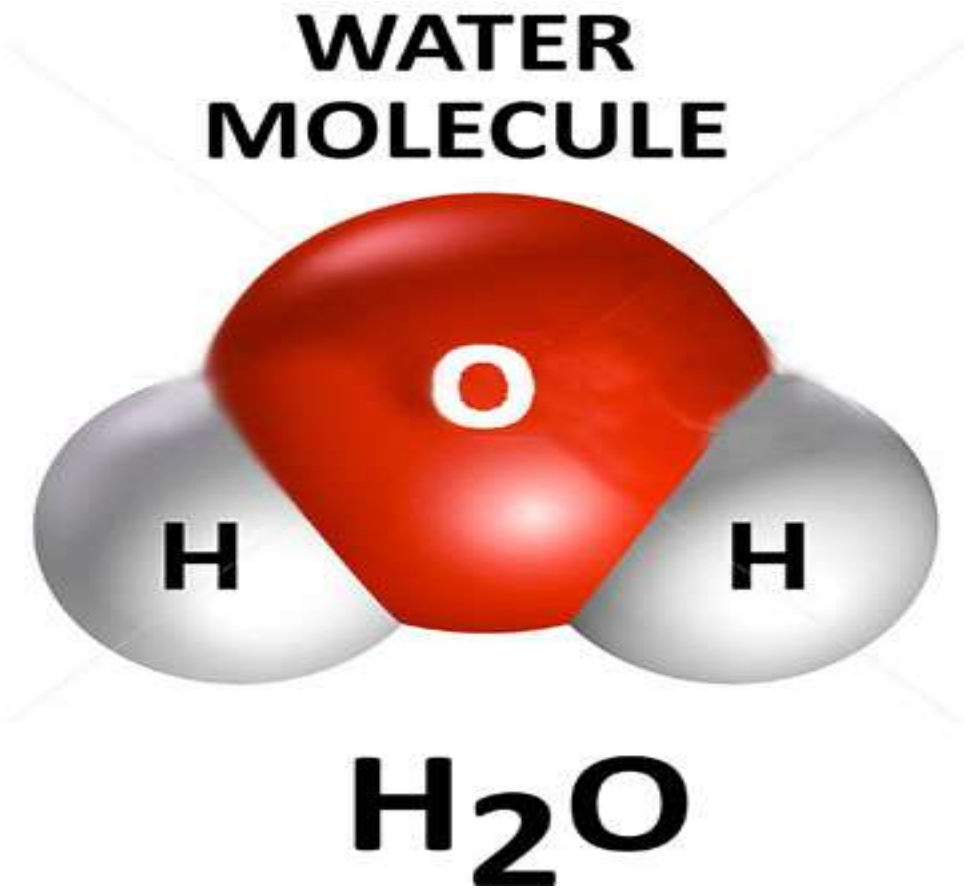

Staphylcoccus
Streptococcus
Enterococcus
*Peptostreptococcus*
*Clostridium*
*Actinomyces*
Neisseria
Moraxella
E.coli, Proteus, Klebsiella,
Serratia, Enterobacter,
Shigella, Salmonella,
Yersinia, Pseudomonas,
Stenotrophomonas,
*Bacteroides*


Photo: Jamil. F. Jaber



# Water Microbiology

# What is Water?



# What is Water? .. Watch Video

# Waterborne Diseases

Bacterial:

- Cholera by *Vibrio Choloerae*

# Waterborne Diseases

- Protozoan infections :
  - Such as giardiasis and cryptosporidiosis


# Why not test waterborne pathogens?

1. Safety
2. Time
3. Cost
4. Large Sample

# MICROBIAL INDICATORS

# Definitions

Microbial Indicators are:

- Microorganism or group of microorganisms that its presence in water indicate the possibility of pathogens contamination,
- Its absence indicates no pathogenic contamination.

# Microbial Indicators

## Water Treatment and Quality:

- Total plate Count (Heterotrophic Plate Count)
- Total Coliform

## Fecal Pollution

- Fecal Coliform (Thermotolerant Coliform)
- Fecal Streptococcus (Enterococci )

# المواصفة المصرية لمياه الشرب (طبقاً لقرار وزير الصحة رقم 458 لسنة – 2007)

| Parameter | Egyptian Decree 458/2007 |
|---|---|
| Heterotrophic Plate Count (HPC) / **1 ml** | ≤ 50 CFU / 1ml |
| Total Coliform (TC) / **100 ml** | ≤ 2 CFU / 100ml |
| Fecal Coli form(FC) / **100 ml** | Free |
| Fecal Streptococci (FS) / **100 ml** | Free |

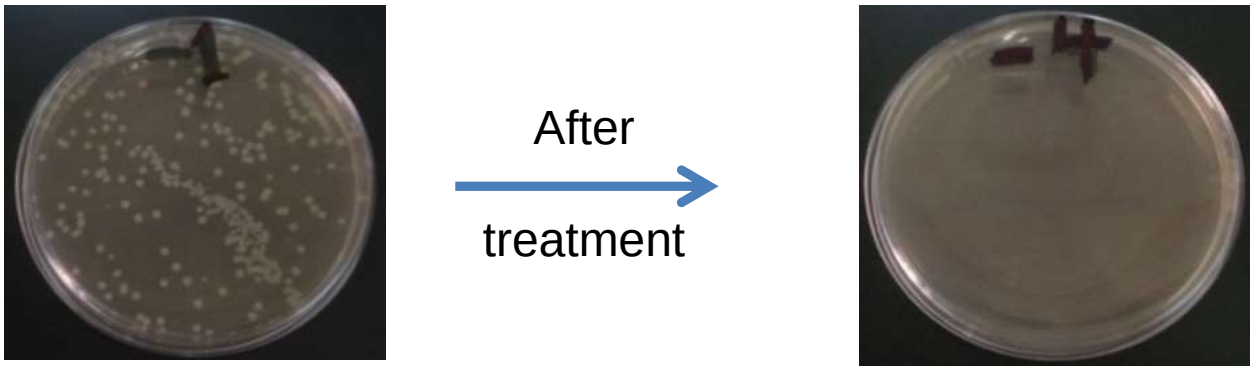
# Why this indicators ?

# Why this indicators ?

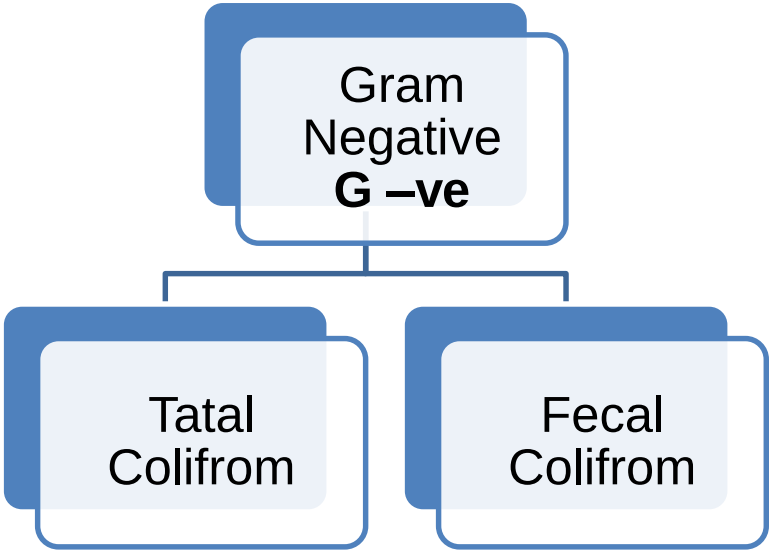
# 1. Heterotrophic Plate Count

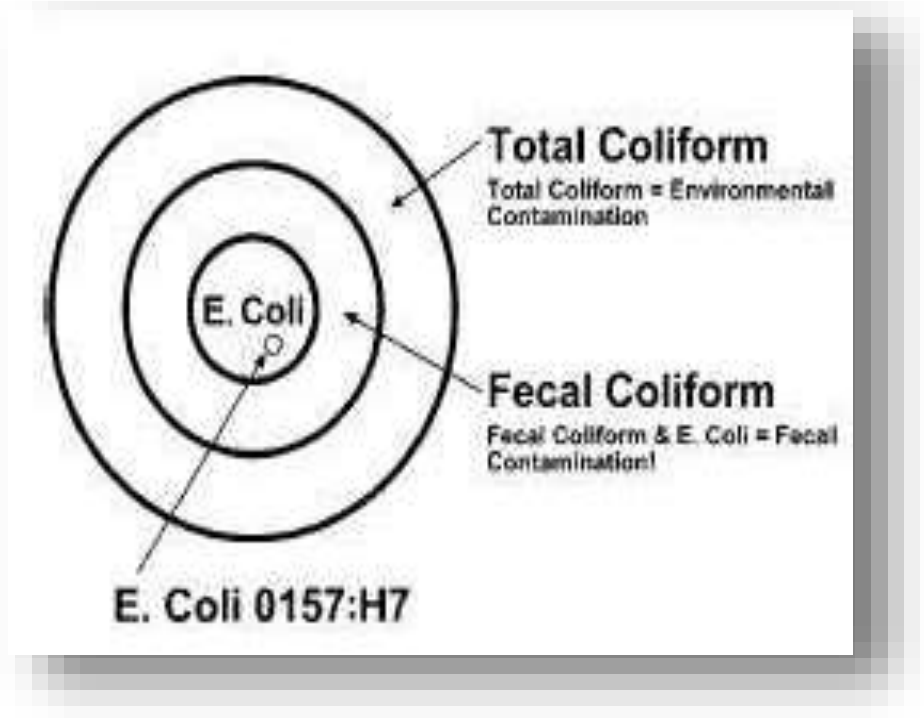
- Estimation of the **overall numbers of bacteria** for :

  - Assessment and observation of water quality
  - Indicator of disinfection efficiency.



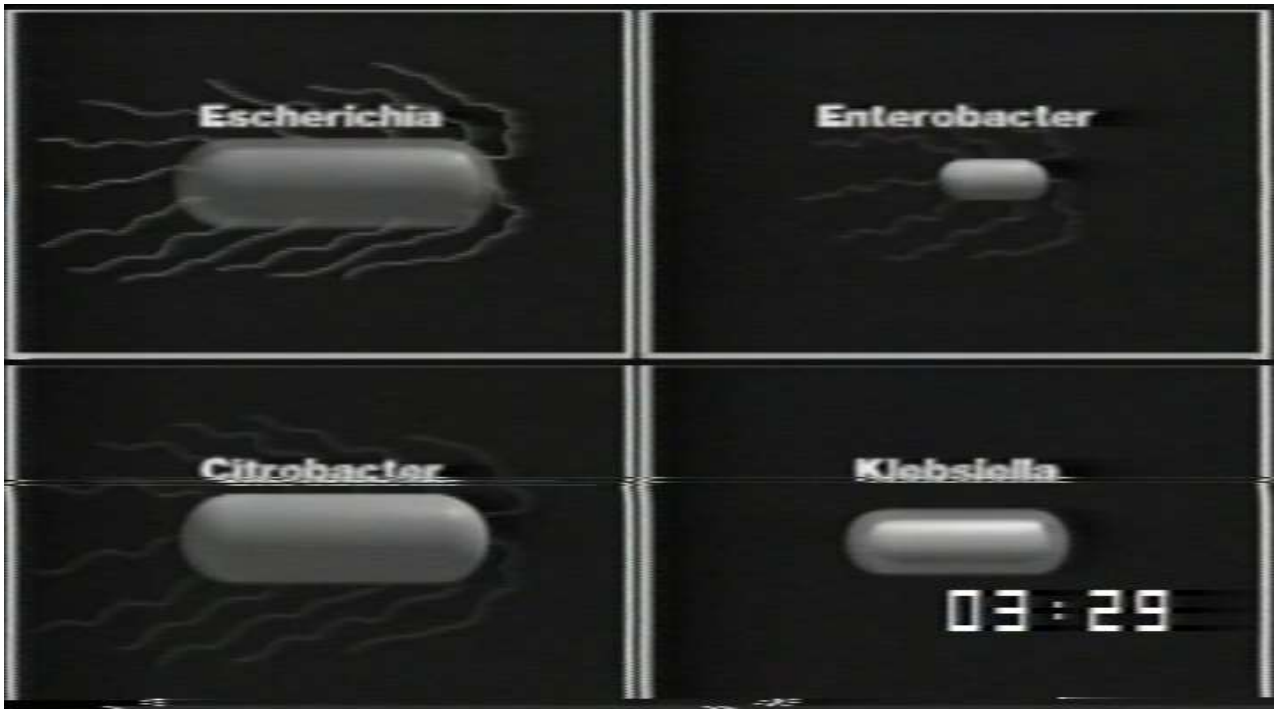
# 2. Gram Negative Bacteria Indicator (G –ve)



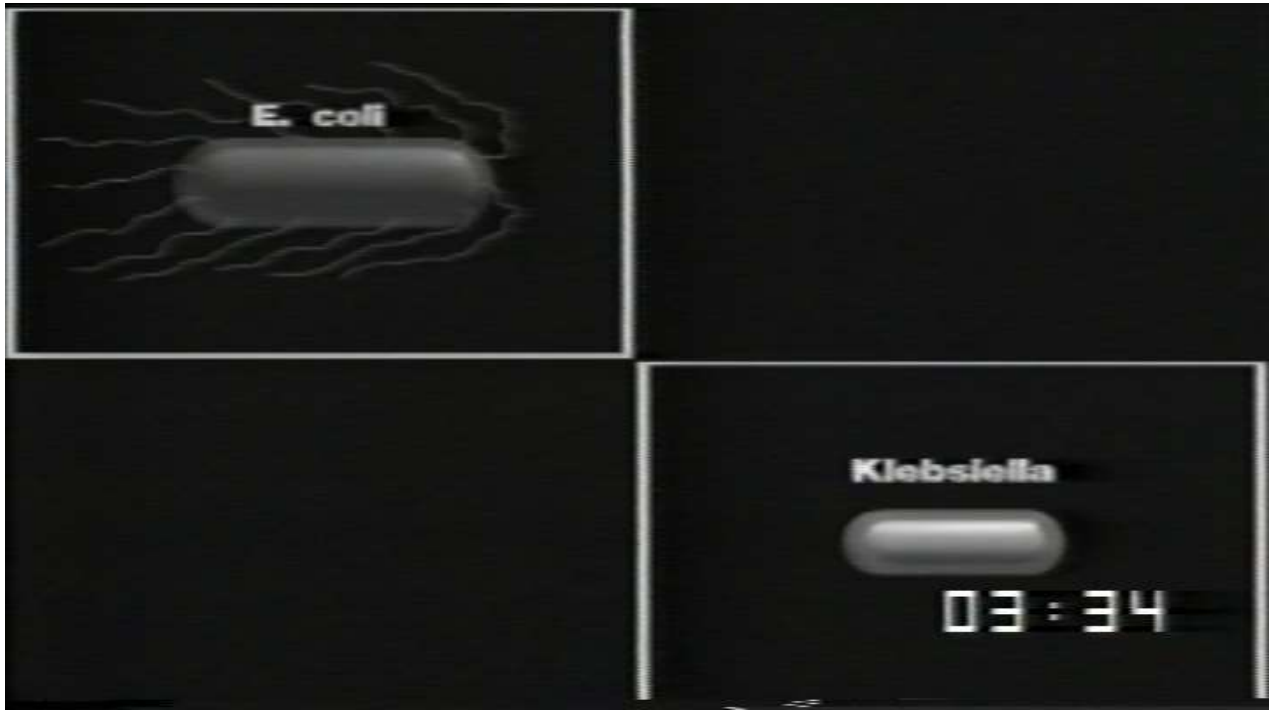
# 2. Gram Negative Bacteria Indicator (G –ve)

## Total Coliform (TC)



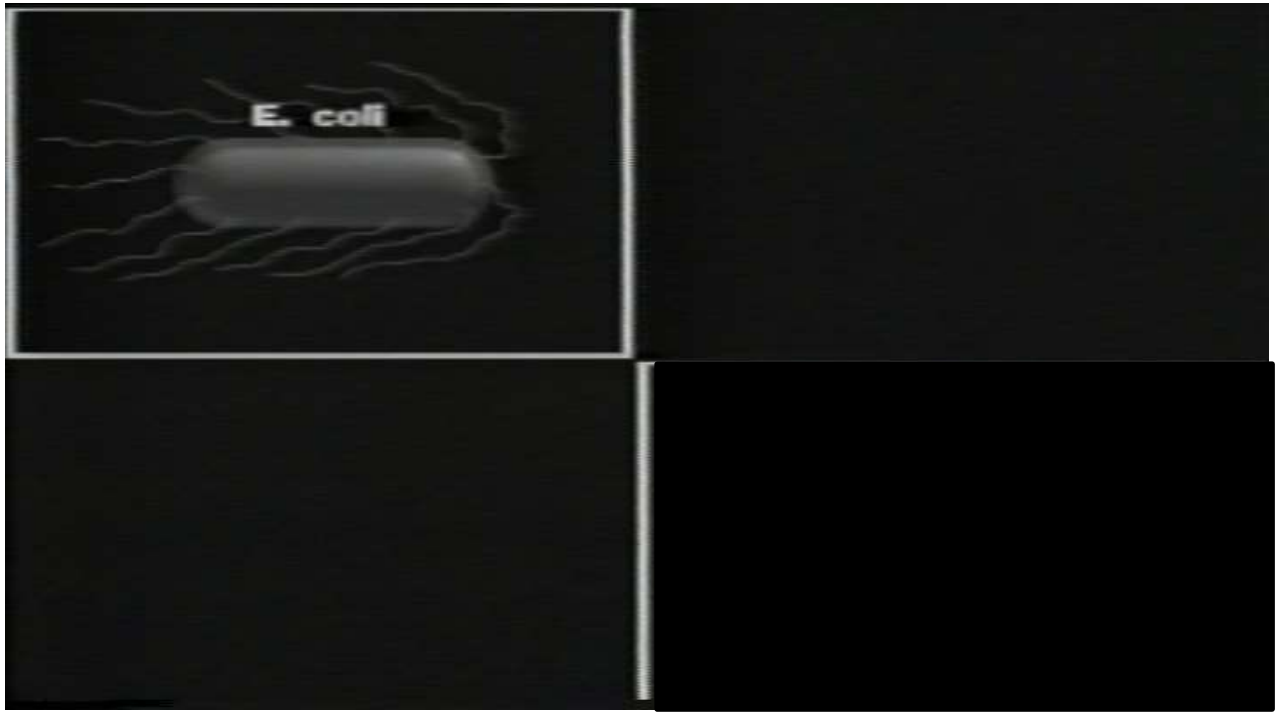
# 2. Gram Negative Bacteria Indicator (G –ve)

## Fecal Coliform (FC)

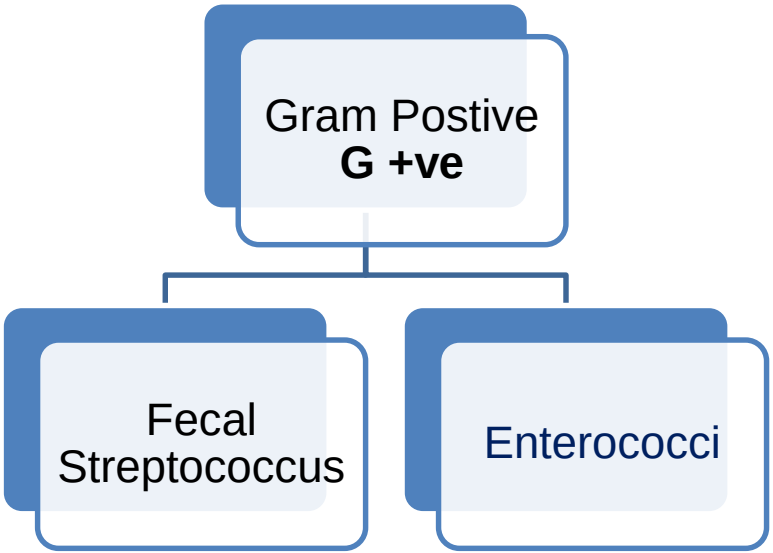


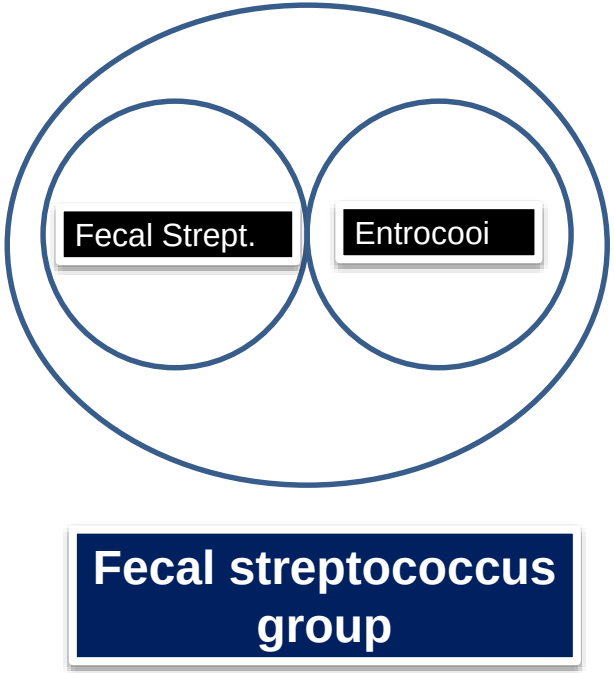
# 2. Gram Negative Bacteria Indicator (G –ve)

E.coli

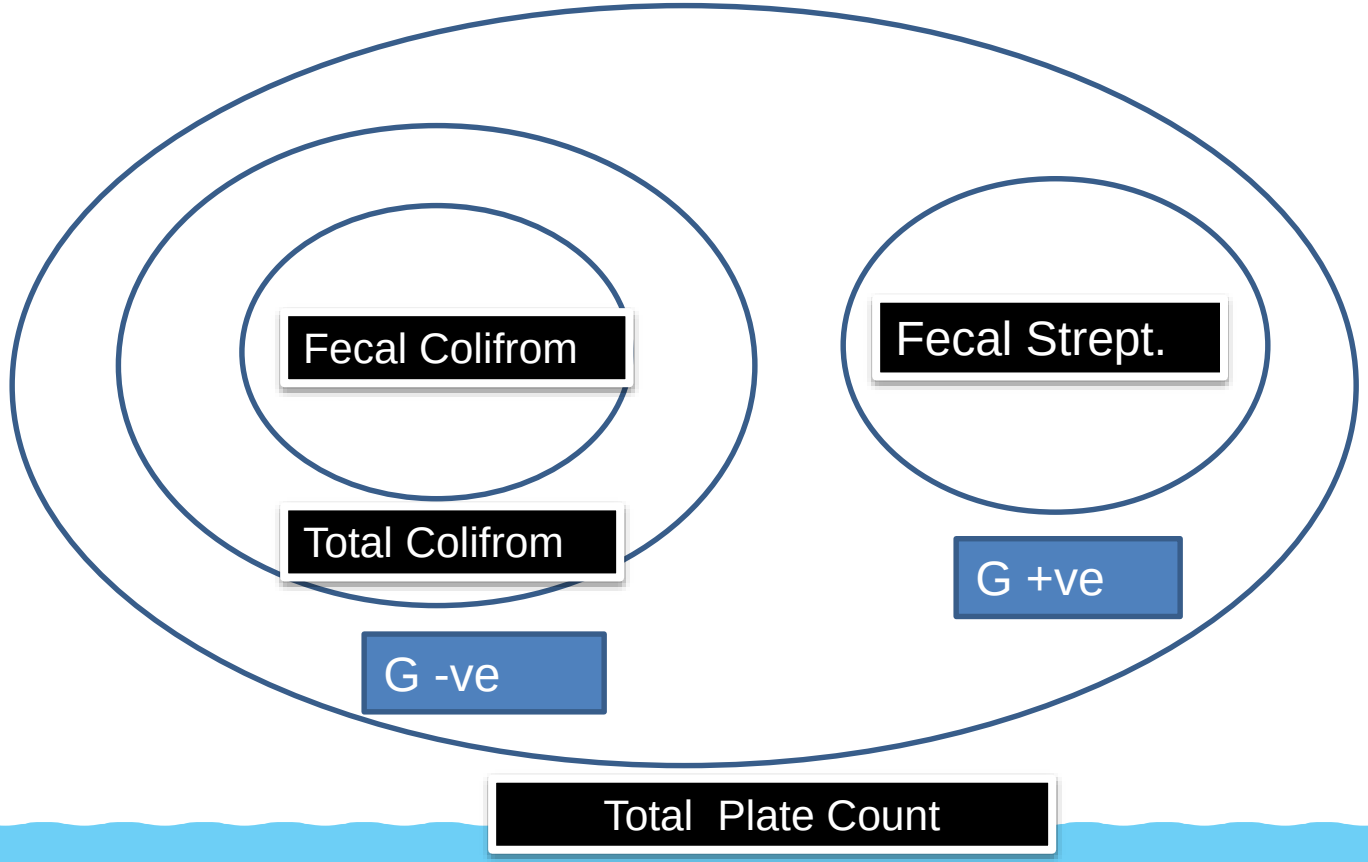


# 3. Gram Positive Bacteria Indicator (G +ve)



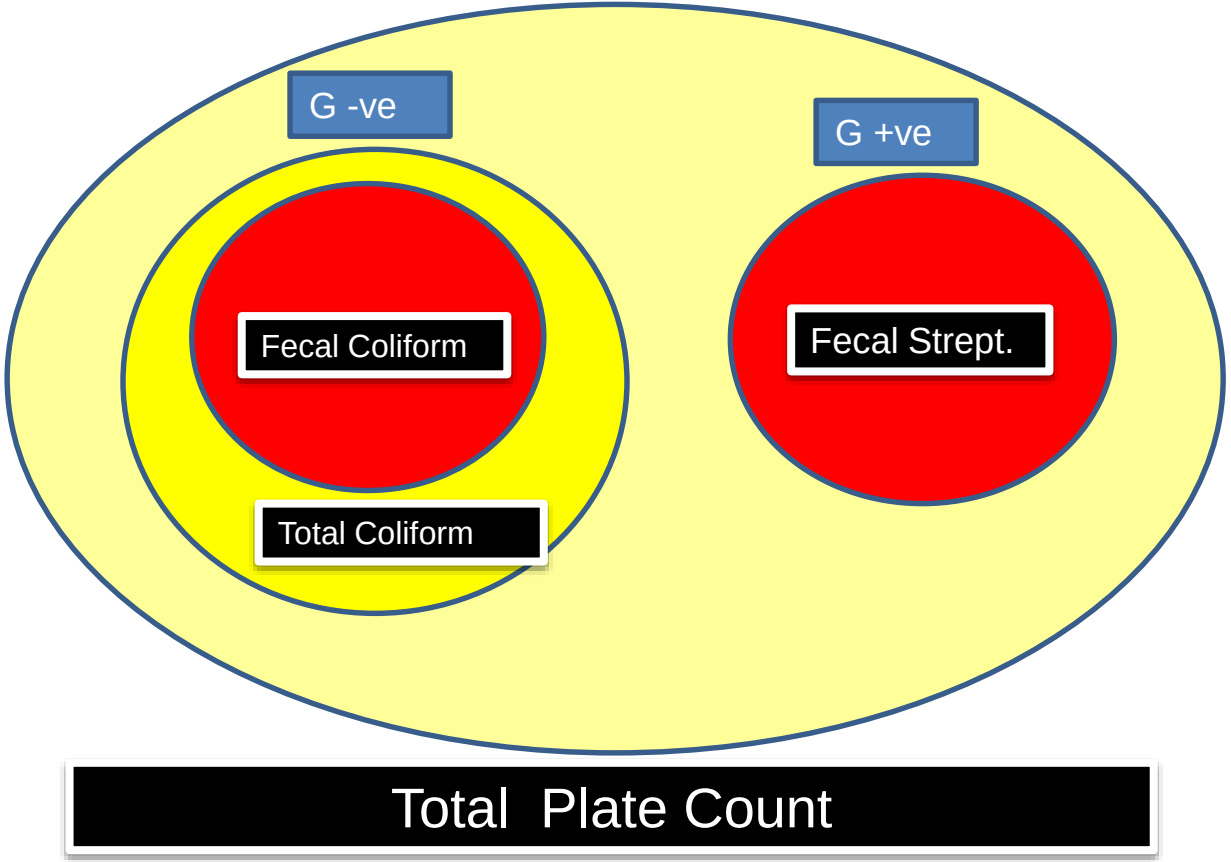




BREAK


Fecal Colifrom
Fecal Strept.
Total Colifrom
G +ve
G -ve
Total Plate Count

# Bacterial Indicators

| Type | Habitat | Gram Stain |
|---|---|---|
| Total coliforms | **Gut** of warm-blooded animals, soil, plant matter, and water environment | Gram negative |
| Fecal coliforms | **Intestines** of warm-blooded animals; some in soil and plant matter, and water environment | Gram negative |
| E. coli | **Intestines** of warm-blooded animals | Gram negative |
| Fecal streptococci | **Intestines** of of warm blooded animals | Gram positive |
| Enterococci | **Intestines** of of warm blooded animals | Gram positive |


G -ve
G +ve
Fecal Coliform
Fecal Strept.
Total Coliform
Total Plate Count

# Pseudomonas aeruginosa

**سیدوموناس ایریوجینوزا**

# Pseudomonas aeruginosa


# Pseudomonas aeruginosa

- تعتبر بكتيريا السيدوموناس Pseudomonas فريدة من نوعها لأنها قادرة على الانتشار فى نوعيات واسعة من البيئات (التربة، والمياه، والنباتات، والجلد)

- هذه البكتيريا تأقلمت من حيث التمثيل الغذائى لكى تبقى حية حتى على الحد الأدنى من المغذيات والتى هى من خواص مياه الشرب والمياه الجوفية.


# Watch Video


THE FOLLOWING PREVIEW HAS BEEN APPROVED FOR
ALL AUDIENCES
INCLUDING THE DEAN
BY THE MOTION PICTURE ASSOCIATION OF MICROBIOLOGY

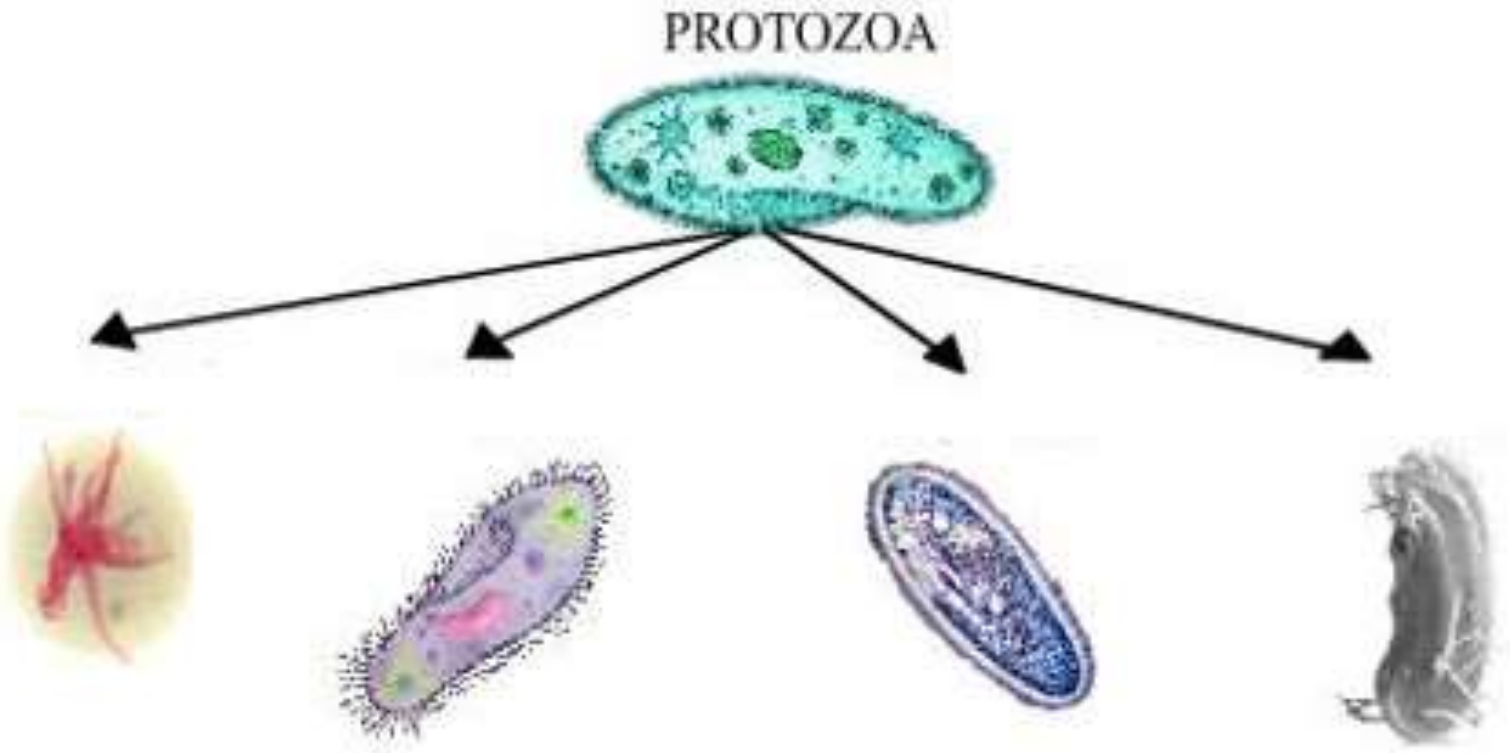
# Protozoa

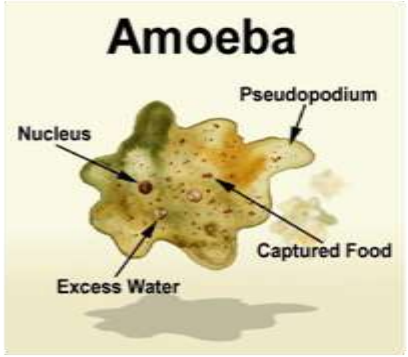
# Protozoa

- Protozoa are found in all moist habitats.
- They are unicellular organisms.
- Polluted waters often have a rich of protozoa.
- protozoa are used as **indicators of organic and toxic pollution**.
- **Resistant to chlorine.**

# Protozoan infections :

- Such as giardiasis and cryptosporidiosis



PROTOZOA

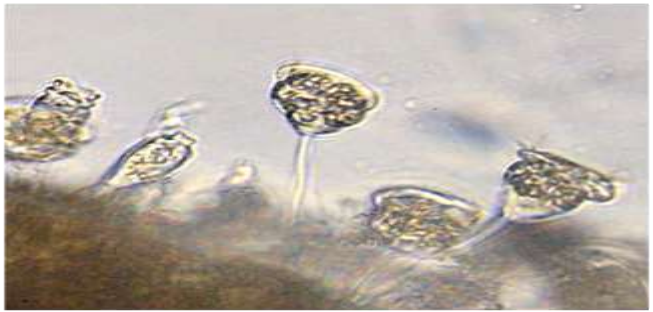



Flagellates, plant-like

Flagellates, animal-like

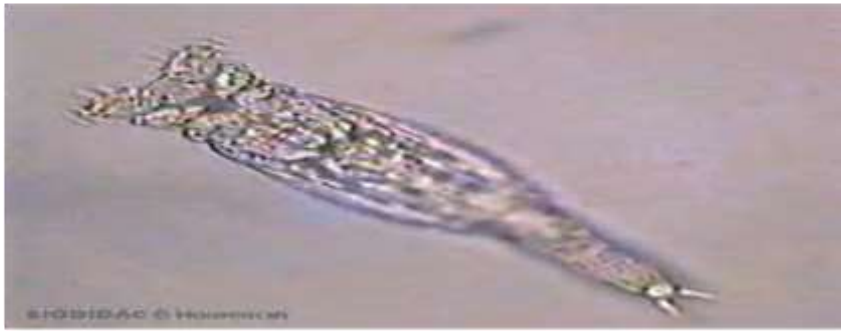
Free-swimming ciliates

Crawling ciliates



Stalked ciliates

**Nematoda**



**Rotifera**

# Alage

# Algae

- Algae are widely present in freshwater environments.
- Visible only with the aid of a light microscope.
- They are autotrophic and photosynthetic

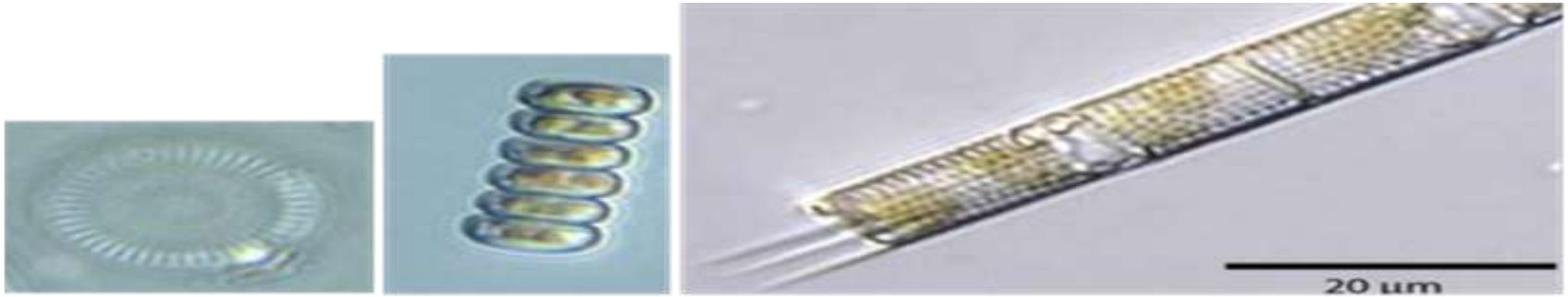
# Factors Influencing Algal Growth

- Physical factors:
    1. Size of Streams
    2. Current Rate
    3. Water Level
    4. Depth
    5. Light
    6. Turbidity
    7. Temperature

# The main Phytoplankton Classes in River Nile

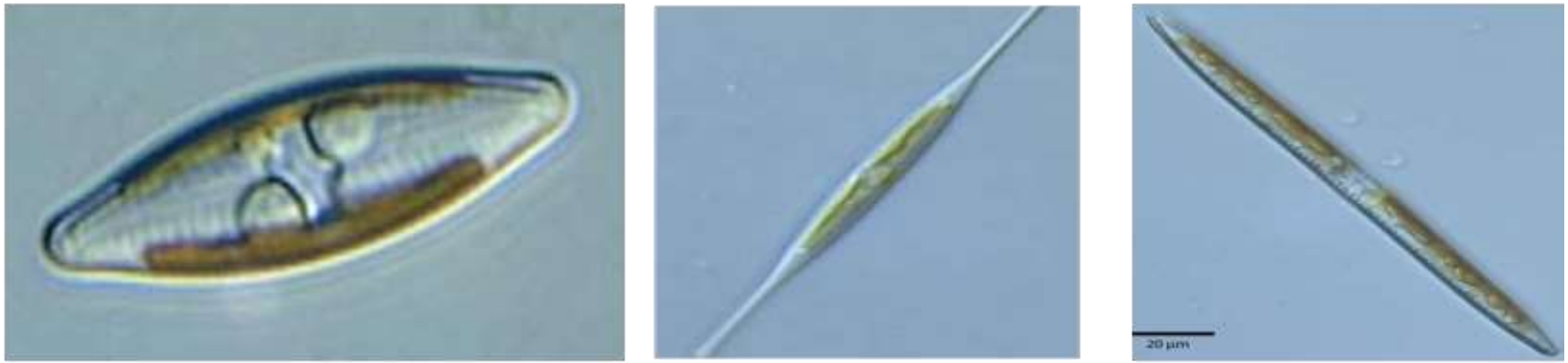
1. **Bacillario**phyceae (Diatoms)
2. **Chloro**phyceae (Green algae)
3. **Cyano**phyceae (Blue-Green algae)
4. **Crypto**phyceae (Cryptomonads)
5. **Chryso**phyceae (Golden-Brown algae)
6. **Dino**phyceae (Dinoflagellates)
7. **Eugleno**phyceae (Euglenoids)

# Diatoms




Cyclotella

Melosira




Navicula

Nitzschia

# Diatoms

Synda

Cymatopleura

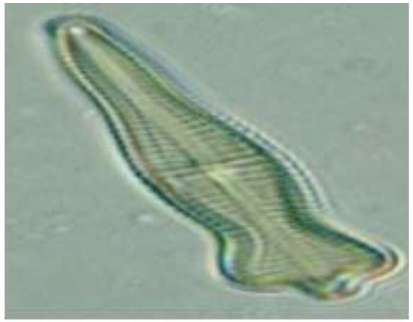
Amphora

Caloneis

Cocconeis

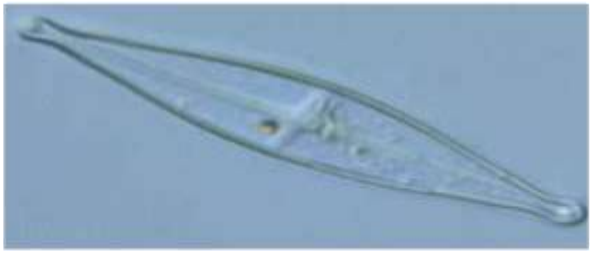
Cymbella

# Diatoms

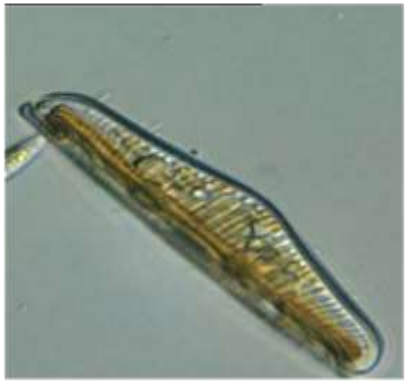


Gomphonema

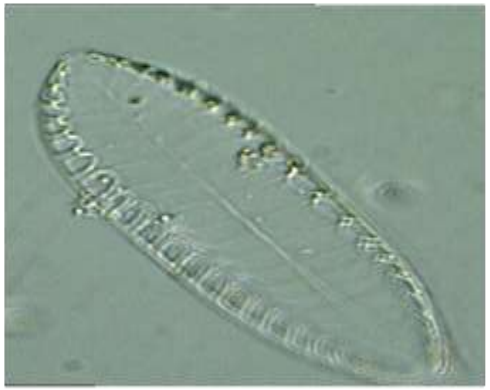
Gyrosigma



Stauroneis

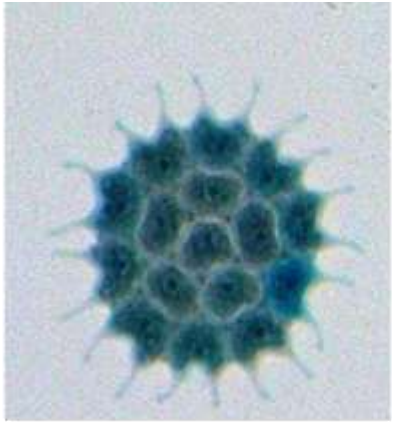


Rhopalodia



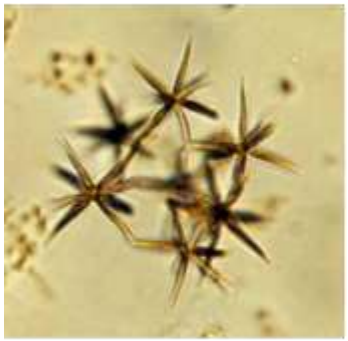
Surirella

# Chlorophyceae (Green algae)

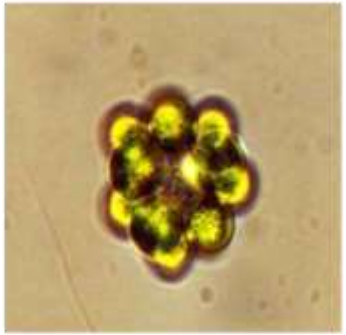


Chlorophyceae

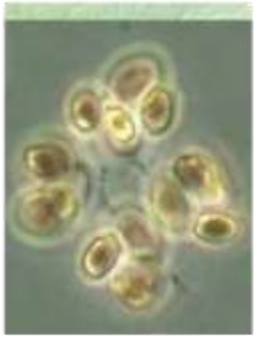
Pediastrum

Actinastrum



Coelastrum



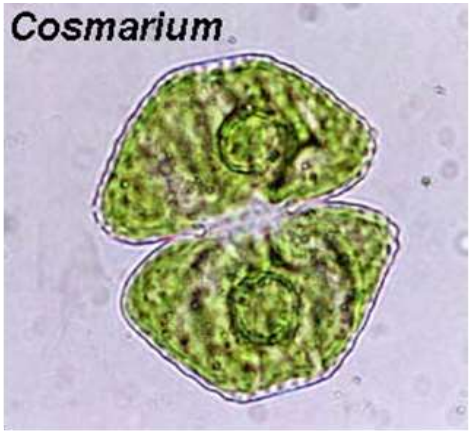
Dictyosphaerium

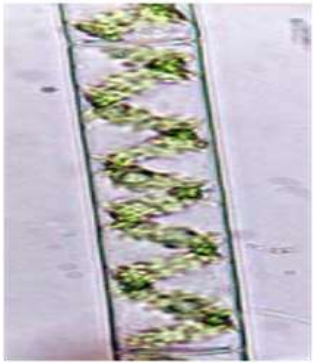
Planktonema

Oocystis

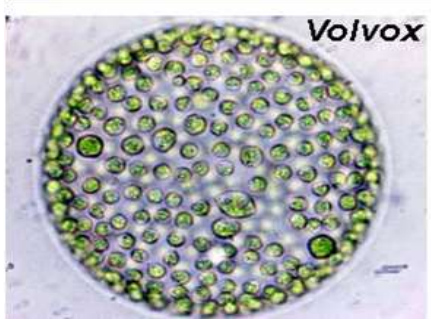
# Chlorophyceae (Green algae)

Ankistrodesmus

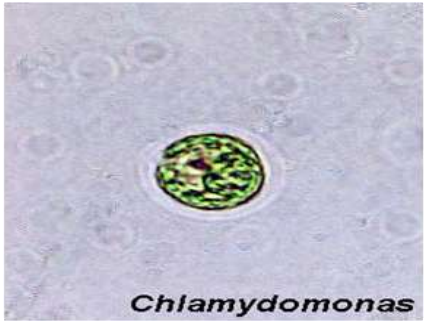


Spirogyra

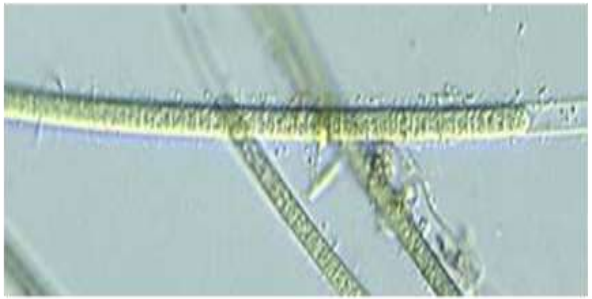




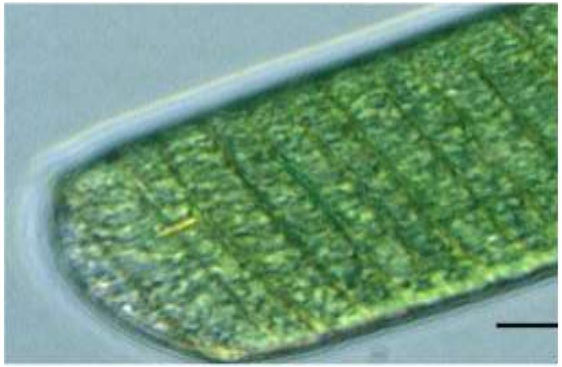
# Cyanophyceae (Blue-green algae)

Chroococcus

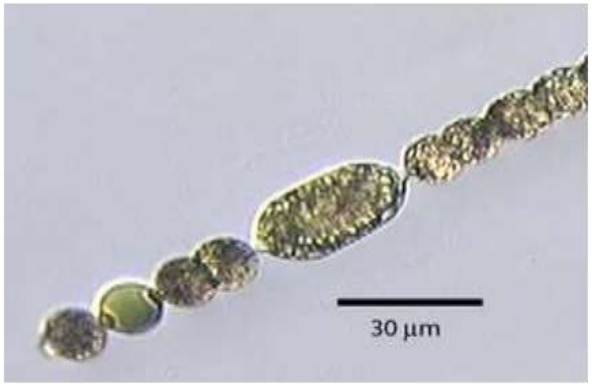
Microcystis



Lyngbya



Oscillatoria



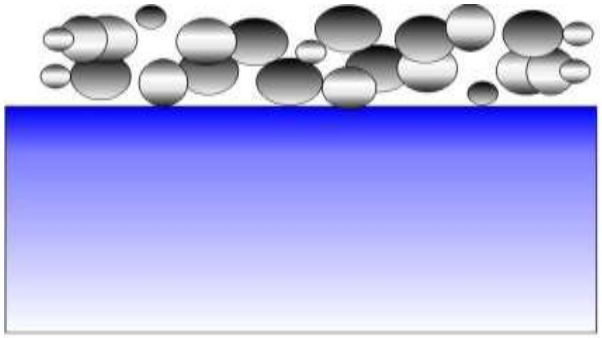

Anabaena

Merismopedia

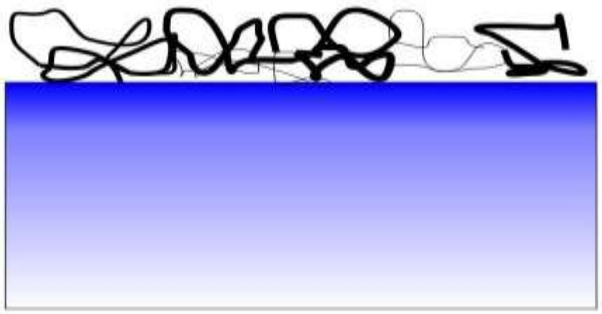

BREAK

# RO Microbiology Problems

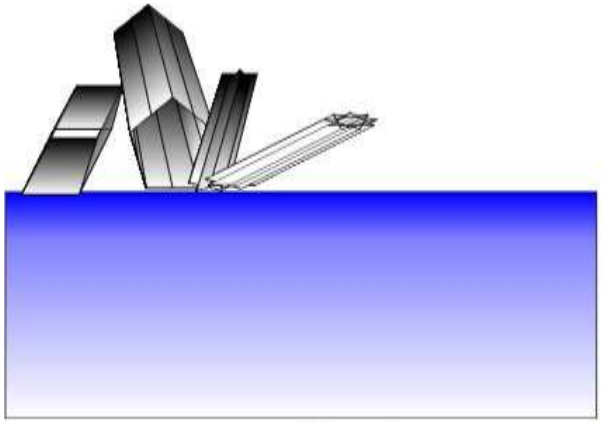
# Fouling types



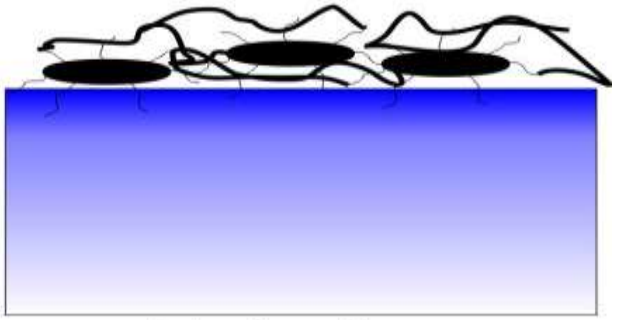
colloidal fouling



organic fouling

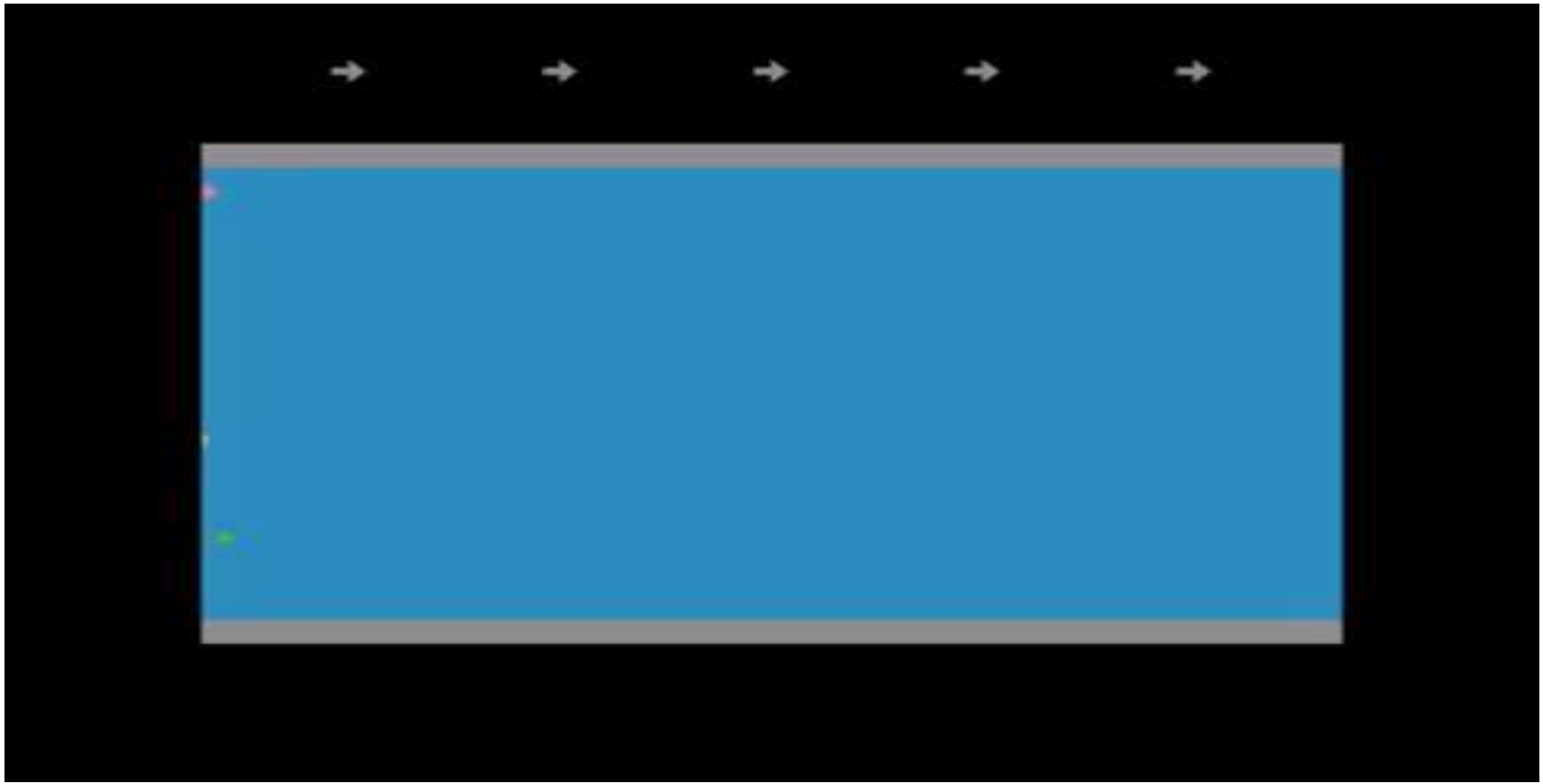


scaling



biofouling

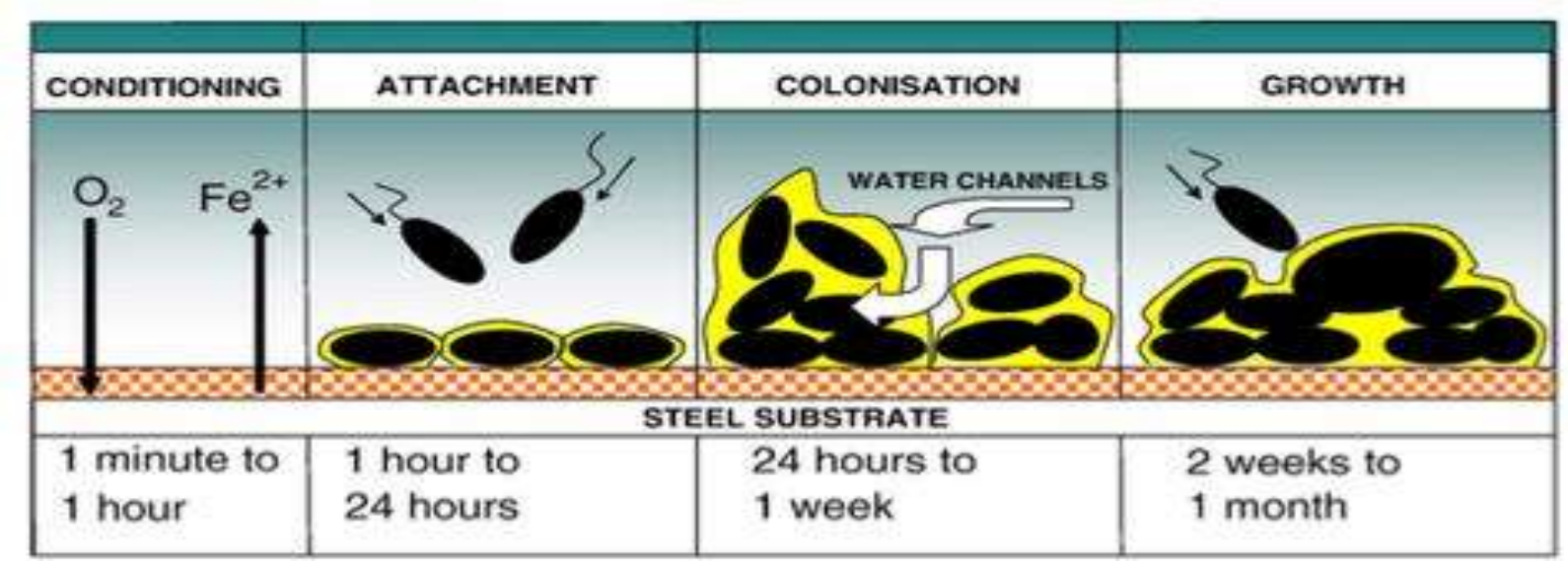
# Watch Video



# Watch Video

# process of biofilm

1. Adsorption of  molecules to a hard surface.
2. Bacteria and microorganisms adhere to the surface
3. Bacteria  colonization to create a biofilm.

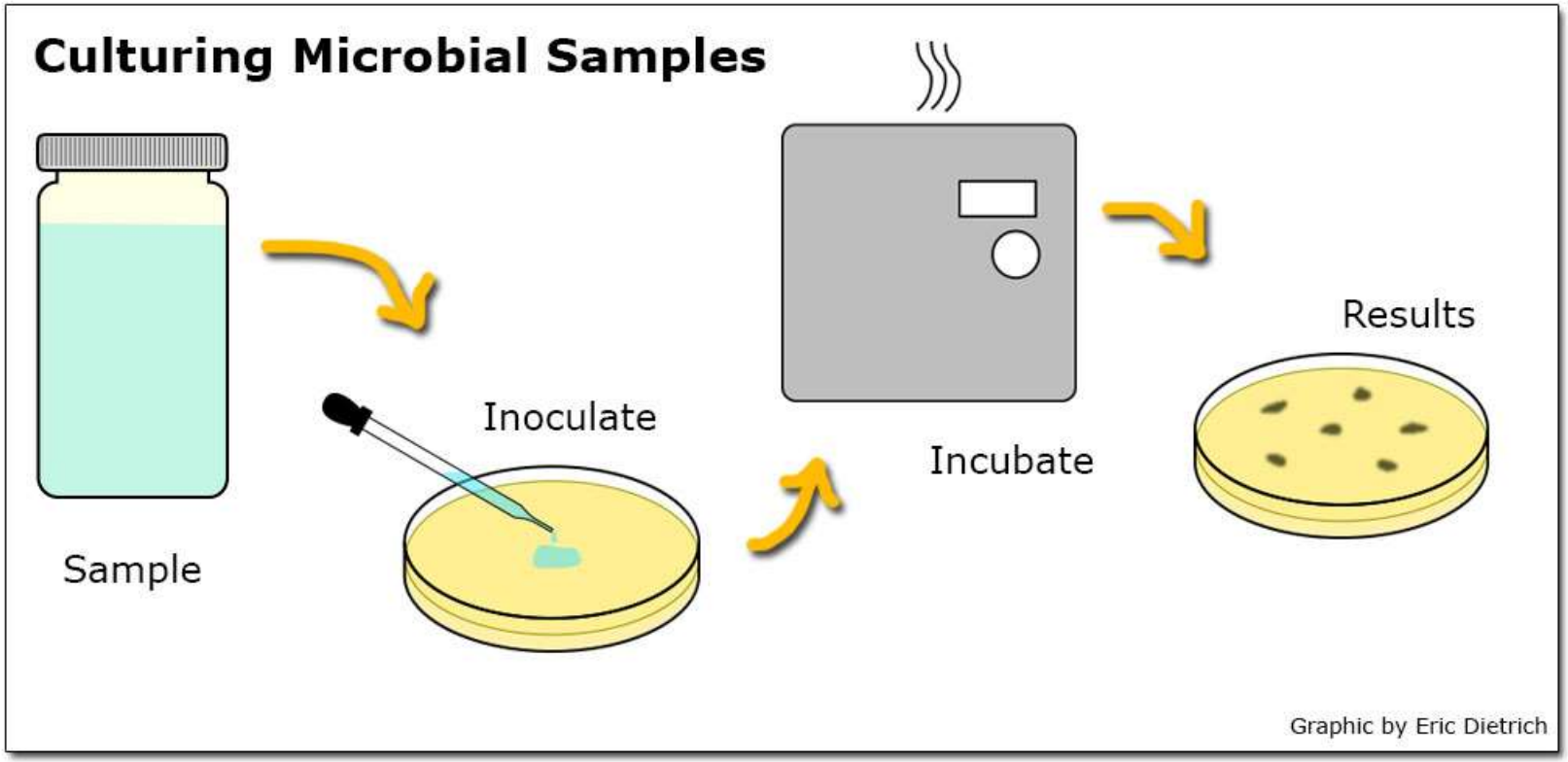



u think the bottled w
Treated with UV
Packed and k


Drinking Water
bdnews24.co

# Water Microbiology Methods

# Microbiology Lab. Overview


Culturing Microbial Samples
Sample
Inoculate
Incubate
Results
Graphic by Eric Dietrich

# Microbial Tests:

1. **Total Plate Count (**Heterotrophic Plate Count**)**
2. **Total coliforms**
3. **Fecal coliforms**
4. **Fecal streptococci (Enterococci)**

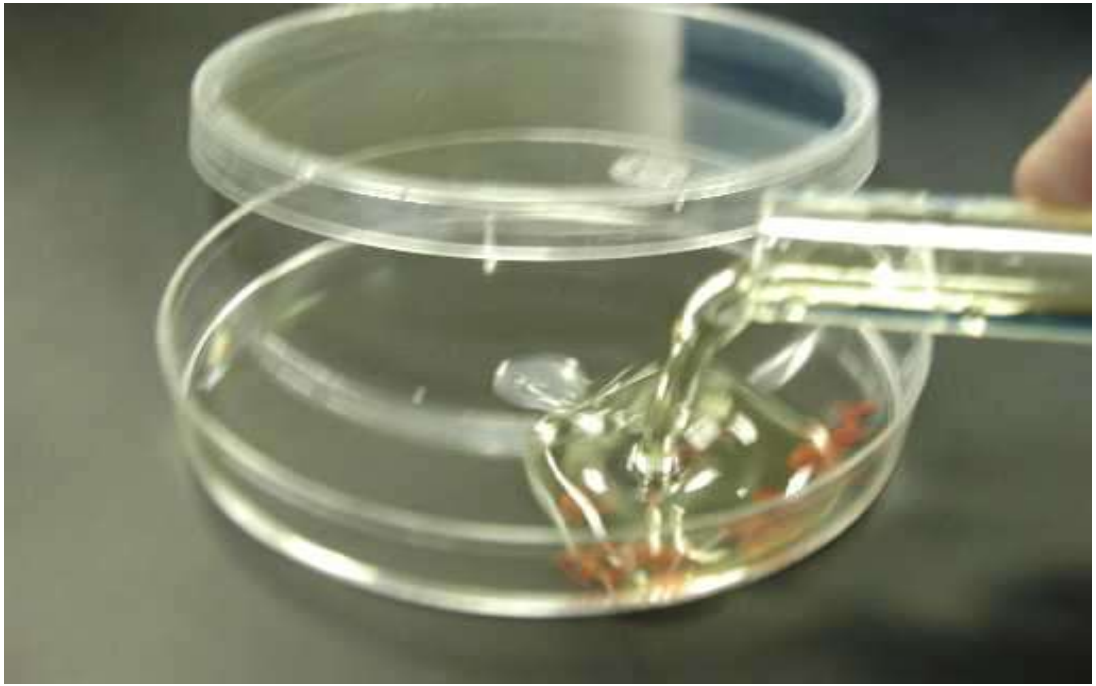
# Microbiology Sampling

# Microbiology Sampling

# Total Plate Count

## (Heterotrophic Plate Count)

# Total Plate Count (Pour plate Method)



# Total Plate Count (Pour plate Method)

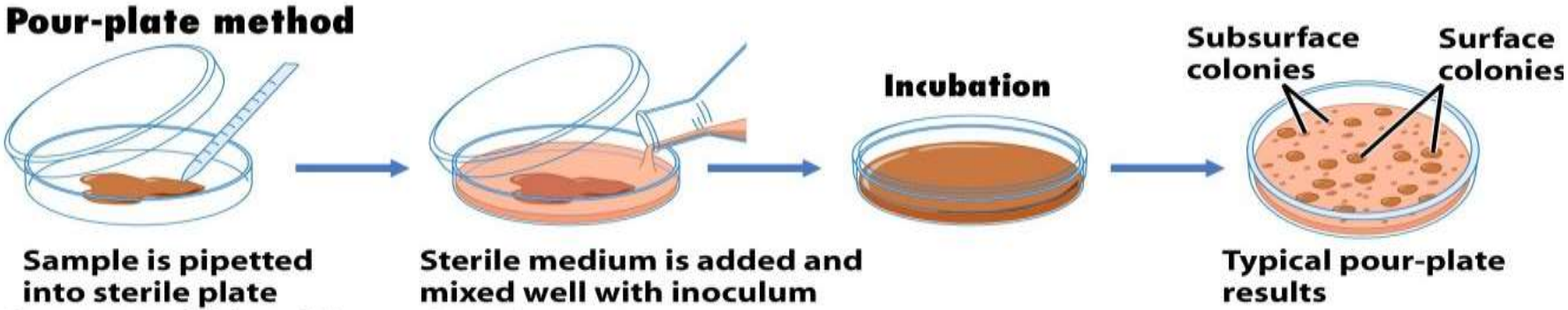
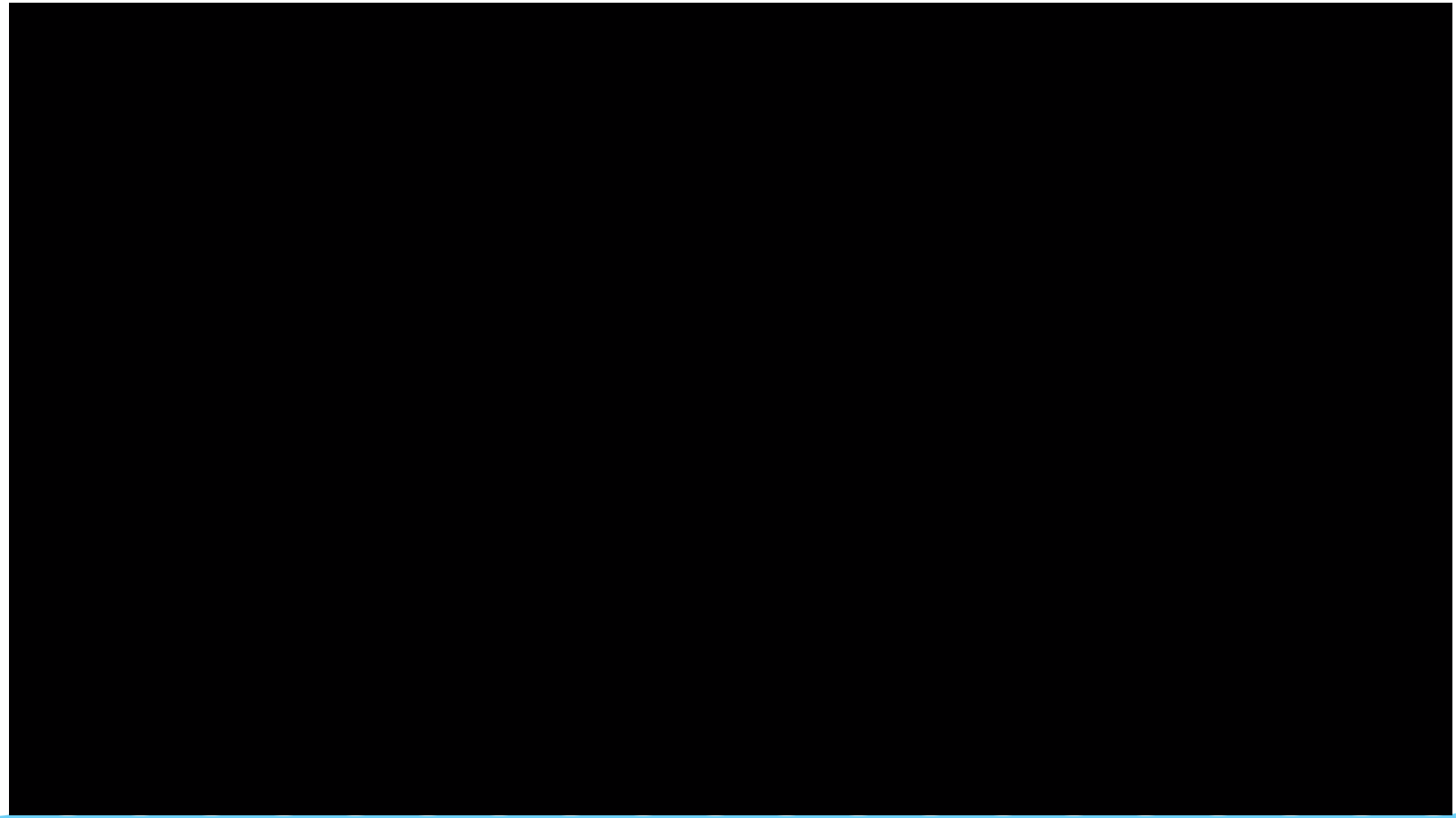
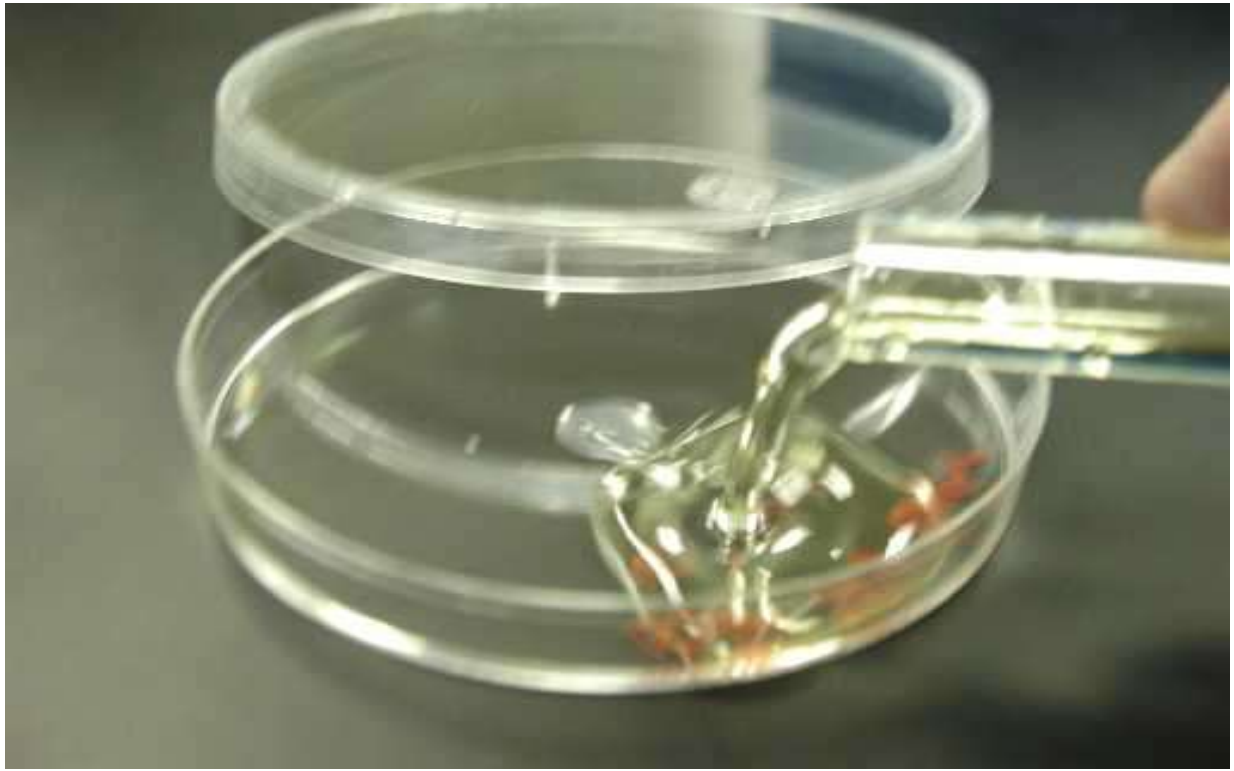



Figure 6-10 Brock Biology of Microorganisms 11/e
© 2006 Pearson Prentice Hall, Inc.

# Total Plate Count (Pour plate Method)



# Total Plate Count (Pour plate Method)



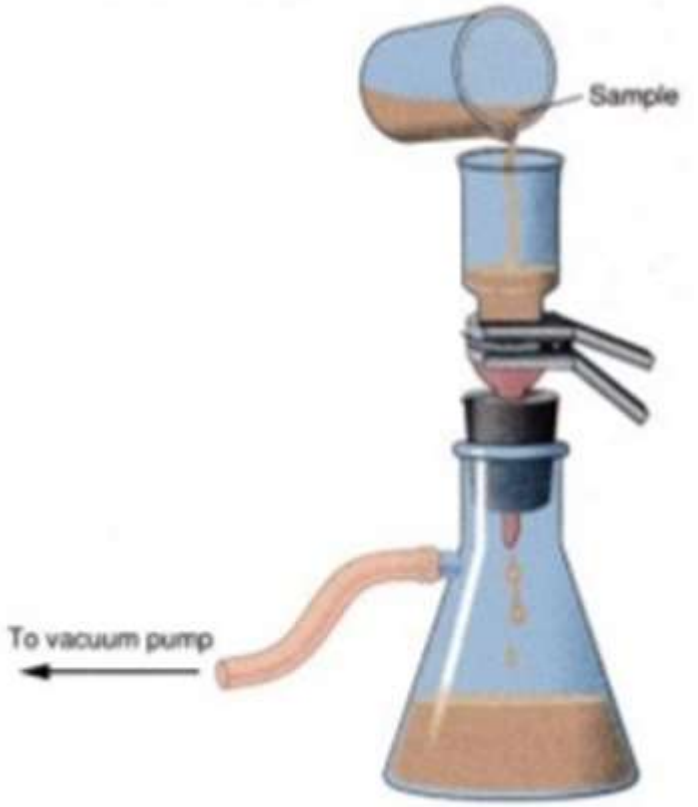
# Incubation :

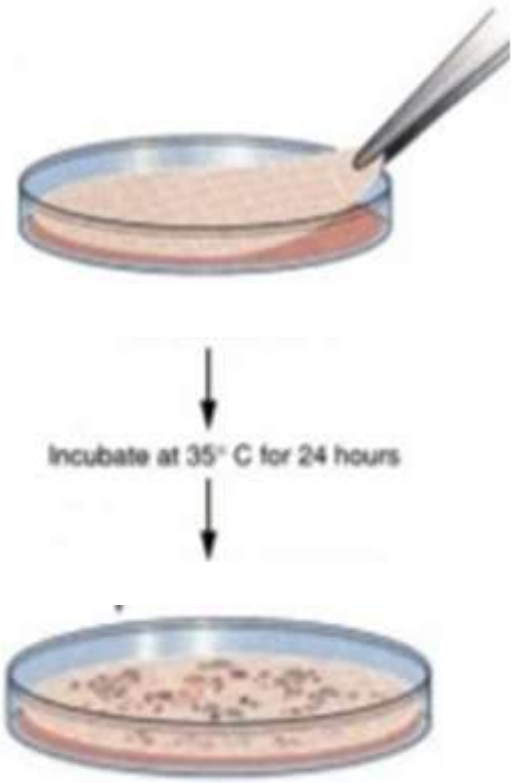
- Invert and incubate plates at **35°C for 48hr** and/or **20-28°C for 5-7 days**.


-4

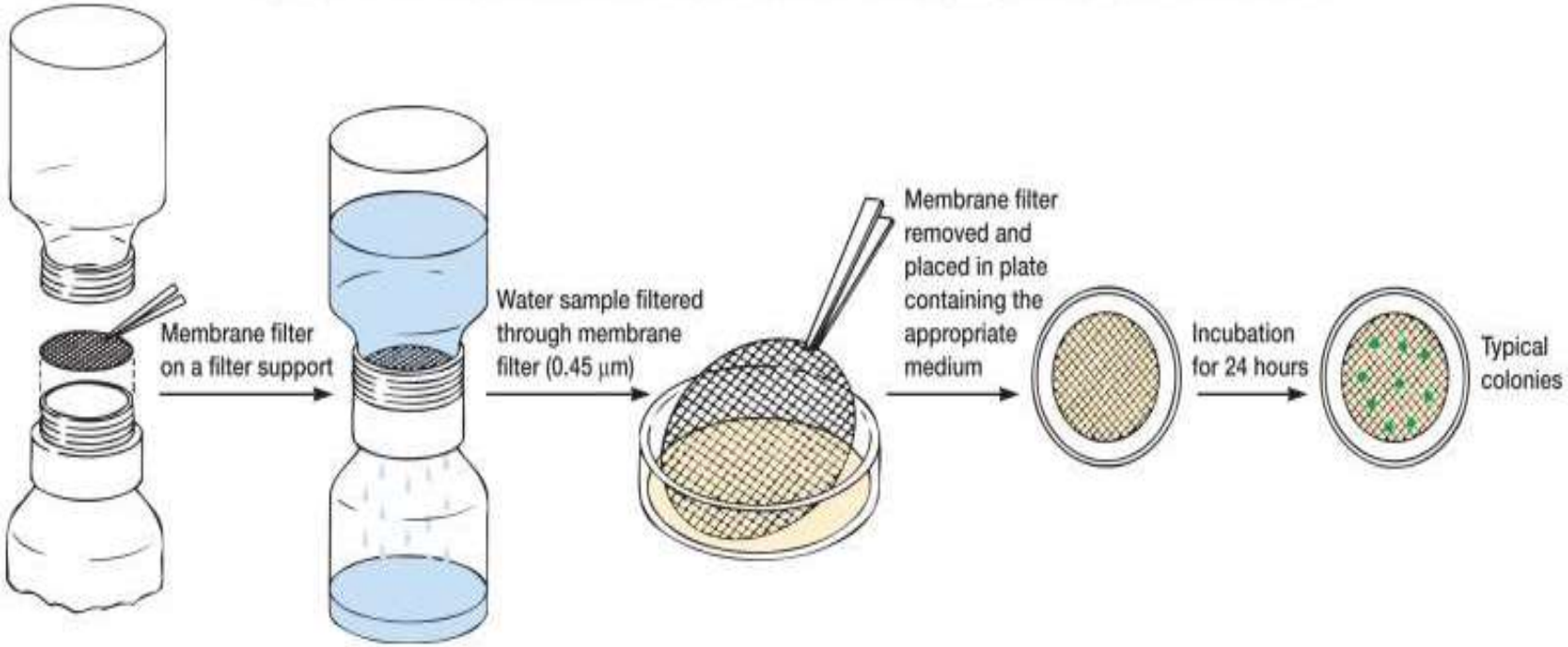
# Membrane Filter Technique

# Membrane Filter Technique



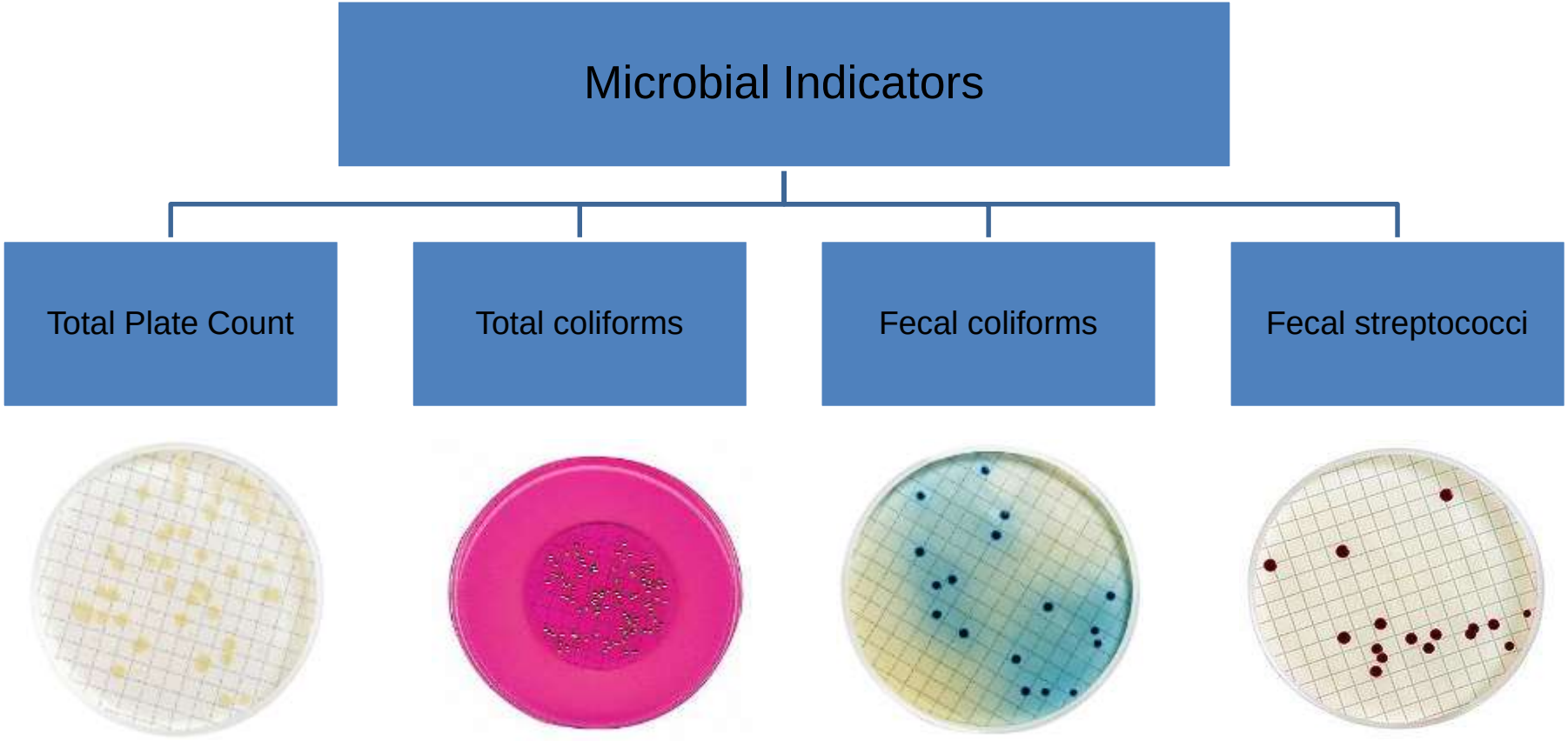



# Membrane Filter Technique



# Membrane Filter Technique

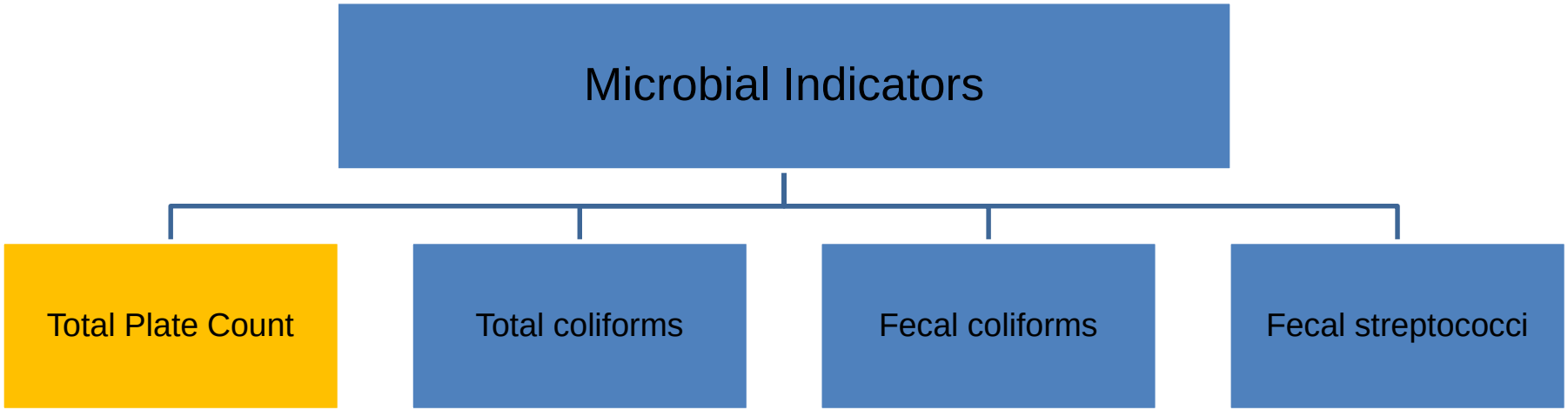
# Membrane Filter Technique



# Membrane Filter Technique

# *Enzyme substrate*
# Technique

# *Enzyme substrate* Technique




# Total Plate Count ( SimPlate® )

# Total Plate Count ( SimPlate® )

| الصور التوضيحية | خطوات تجربة عدً البكتريا الكلى بطريقة الإنزيمات |
|---|---|
|  | - يتم اذابة البودر فى 100 مل ماء معقم.<br>- Add 100 mL sterile diluent to media vessel. |
|  | - نضع 1 مل من العينة المختبرة فى وسط الطبق.<br>- Add 1 mL sample to SimPlate. |
|  | - نضع 9 مل من الوسط الغذائى على الطبق.<br>- Add 9 mL media to SimPlate. |
|  | - نقوم بهز الطبق برفق لتوزيع العينة داخل الطبق، ثم نقوم بإمالة الطبق حتى يمتص القطن على اطراف الطبق الزيادة من الماء.<br>- Swirl SimPlate and pour off excess. |

# Total Plate Count ( SimPlate® )

| | |
|---|---|
|  | - نضع الطبق فى الحضانة مقلوباً على الوجه عند درجة حرارة 35 لمدة 48 ساعة.<br>- Invert and incubate for 48 hours. |
| | - نقرأ النتائج باستخدام لمبة الاشعة فوق البنفسجية.<br>- Read results under UV light. |

# Equipments

حضانة عند درجة حرارة 35 سيليزية.

مصباح (لمبة) اشعة فوق بنفسجية بمدى 365 نانومتر.

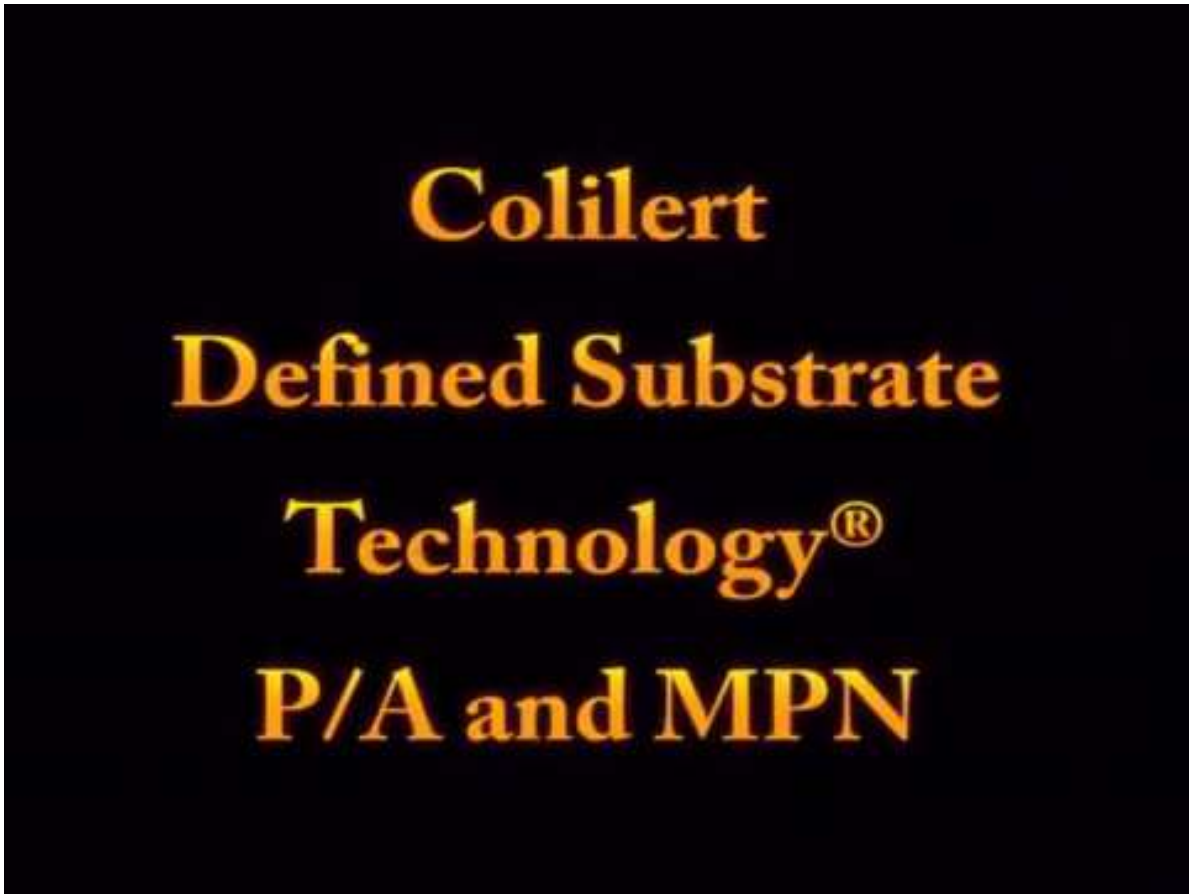
# Total Plate Count ( SimPlate® )

# IDEXX system

| اسم الاختبار | اسم المنتج |
| --- | --- |
| بكتيريا القولون الكلية Total Coliform | Colilert® |
| بكتريا القولون البرازية Fecal Coliform | |
| البكتريا المعوية Enterococcus | Enterolert® |

# Equipments

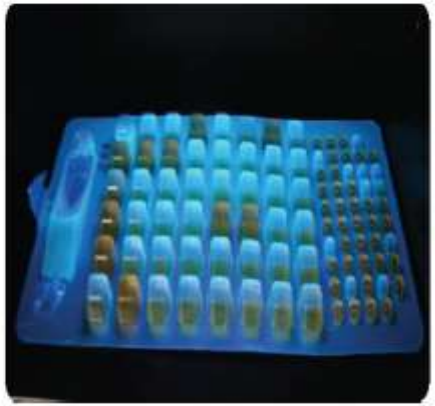
# IDEXX system



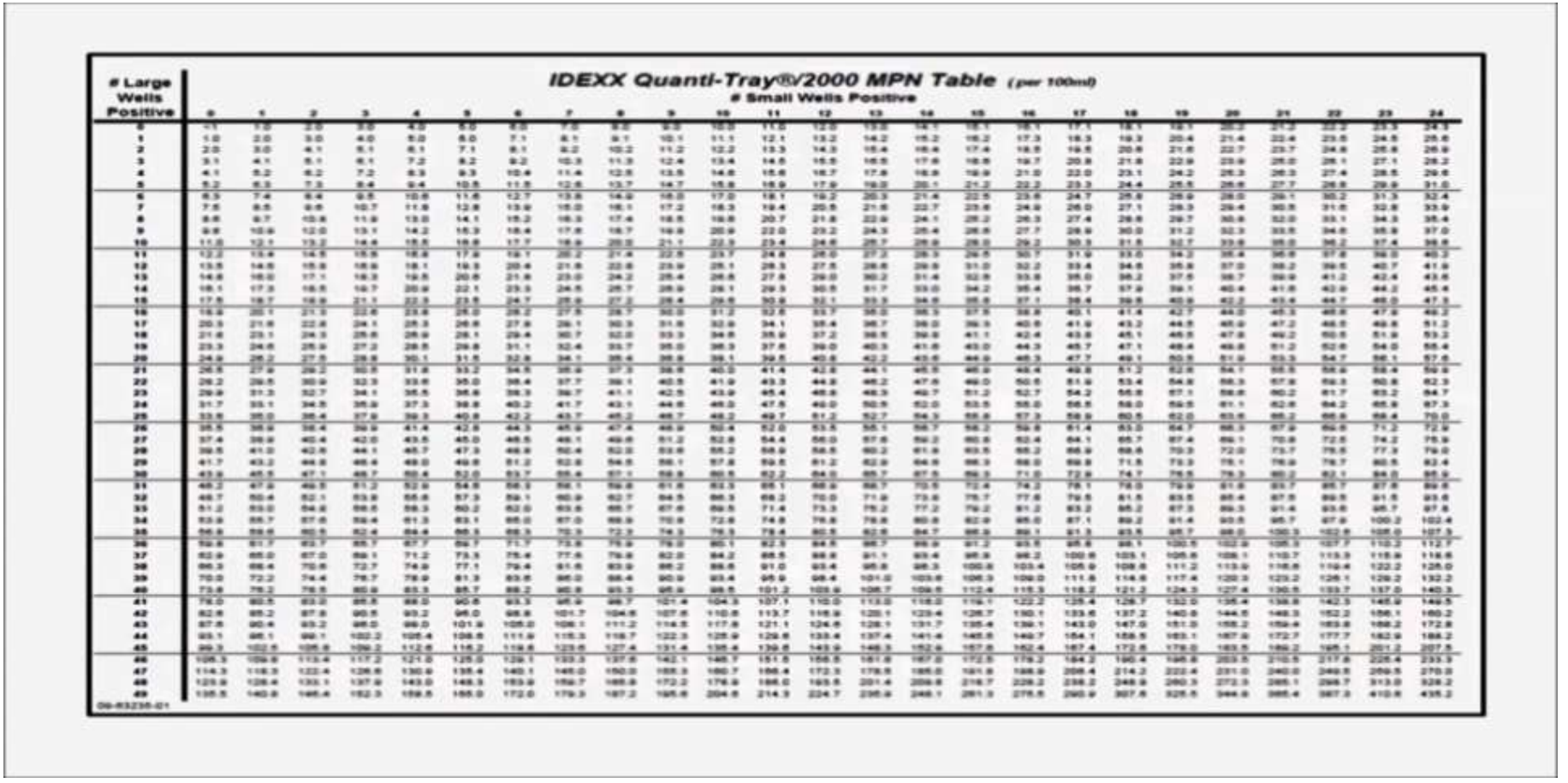
# Result

**Positive Yellow Wells for Total Coliforms or Fecal Coliforms**

***E.coli*- Blue Fluorescence- Quanti-Tray under a 365nm UV Light**



# Read result for IDEXX table



**IDEXX Quanti-Tray®/2000 MPN Table** (per 100ml)

| # Large Wells Positive | # Small Wells Positive | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 |
| 0 | <1 | 1.0 | 2.0 | 3.0 | 4.0 | 5.0 | 6.0 | 7.0 | 8.0 | 9.0 | 10.0 | 11.0 | 12.0 | 13.0 | 14.1 | 15.1 | 16.1 | 17.1 | 18.1 | 19.1 | 20.2 | 21.2 | 22.2 | 23.3 | 24.3 |
| 1 | 1.0 | 2.0 | 3.0 | 4.0 | 5.0 | 6.0 | 7.1 | 8.1 | 9.1 | 10.1 | 11.1 | 12.1 | 13.2 | 14.2 | 15.2 | 16.2 | 17.3 | 18.3 | 19.3 | 20.4 | 21.4 | 22.4 | 23.5 | 24.5 | 25.6 |
| 2 | 2.0 | 3.0 | 4.1 | 5.1 | 6.1 | 7.1 | 8.1 | 9.2 | 10.2 | 11.2 | 12.2 | 13.3 | 14.3 | 15.4 | 16.4 | 17.4 | 18.5 | 19.5 | 20.6 | 21.6 | 22.7 | 23.7 | 24.8 | 25.8 | 26.9 |
| 3 | 3.1 | 4.1 | 5.1 | 6.1 | 7.2 | 8.2 | 9.2 | 10.3 | 11.3 | 12.4 | 13.4 | 14.5 | 15.5 | 16.5 | 17.6 | 18.6 | 19.7 | 20.8 | 21.8 | 22.9 | 23.9 | 25.0 | 26.1 | 27.1 | 28.2 |
| 4 | 4.1 | 5.2 | 6.2 | 7.2 | 8.3 | 9.3 | 10.4 | 11.4 | 12.5 | 13.5 | 14.6 | 15.6 | 16.7 | 17.8 | 18.8 | 19.9 | 21.0 | 22.0 | 23.1 | 24.2 | 25.3 | 26.3 | 27.4 | 28.5 | 29.6 |
| 5 | 5.2 | 6.3 | 7.3 | 8.4 | 9.4 | 10.5 | 11.5 | 12.6 | 13.7 | 14.7 | 15.8 | 16.9 | 17.9 | 19.0 | 20.1 | 21.2 | 22.2 | 23.3 | 24.4 | 25.5 | 26.6 | 27.7 | 28.8 | 29.9 | 31.0 |
| 6 | 6.3 | 7.4 | 8.4 | 9.5 | 10.6 | 11.6 | 12.7 | 13.8 | 14.9 | 16.0 | 17.0 | 18.1 | 19.2 | 20.3 | 21.4 | 22.5 | 23.6 | 24.7 | 25.9 | 26.9 | 28.0 | 29.1 | 30.2 | 31.3 | 32.4 |
| 7 | 7.5 | 8.5 | 9.6 | 10.7 | 11.8 | 12.8 | 13.9 | 15.0 | 16.1 | 17.2 | 18.3 | 19.4 | 20.5 | 21.6 | 22.7 | 23.8 | 24.9 | 26.0 | 27.1 | 28.3 | 29.4 | 30.5 | 31.6 | 32.8 | 33.9 |
| 8 | 8.6 | 9.7 | 10.8 | 11.9 | 13.0 | 14.1 | 15.2 | 16.3 | 17.4 | 18.5 | 19.6 | 20.7 | 21.8 | 22.9 | 24.1 | 25.2 | 26.3 | 27.4 | 28.6 | 29.7 | 30.8 | 32.0 | 33.1 | 34.3 | 35.4 |
| 9 | 9.8 | 10.8 | 12.0 | 13.1 | 14.2 | 15.3 | 16.4 | 17.5 | 18.7 | 19.8 | 20.9 | 22.0 | 23.2 | 24.3 | 25.4 | 26.6 | 27.7 | 28.9 | 30.0 | 31.2 | 32.3 | 33.5 | 34.6 | 35.9 | 37.0 |
| 10 | 11.0 | 12.1 | 13.2 | 14.4 | 15.5 | 16.6 | 17.7 | 18.9 | 20.0 | 21.1 | 22.3 | 23.4 | 24.6 | 25.7 | 26.9 | 28.0 | 29.2 | 30.3 | 31.5 | 32.7 | 33.8 | 35.0 | 36.2 | 37.4 | 38.6 |
| 11 | 12.2 | 13.4 | 14.5 | 15.6 | 16.8 | 17.9 | 19.1 | 20.2 | 21.4 | 22.5 | 23.7 | 24.8 | 26.0 | 27.3 | 28.3 | 29.5 | 30.7 | 31.9 | 33.0 | 34.3 | 35.4 | 36.6 | 37.8 | 39.0 | 40.2 |
| 12 | 13.5 | 14.6 | 15.8 | 16.9 | 18.1 | 19.3 | 20.4 | 21.6 | 22.8 | 23.9 | 25.1 | 26.3 | 27.5 | 28.6 | 29.8 | 31.0 | 32.2 | 33.4 | 34.6 | 35.8 | 37.0 | 38.2 | 39.5 | 40.7 | 41.9 |
| 13 | 14.8 | 16.0 | 17.1 | 18.3 | 19.5 | 20.6 | 21.8 | 23.0 | 24.2 | 25.4 | 26.6 | 27.8 | 29.0 | 30.2 | 31.4 | 32.6 | 33.8 | 35.0 | 36.2 | 37.5 | 38.7 | 39.9 | 41.2 | 42.4 | 43.6 |
| 14 | 16.1 | 17.3 | 18.5 | 19.7 | 20.9 | 22.1 | 23.3 | 24.5 | 25.7 | 26.9 | 28.1 | 29.3 | 30.5 | 31.7 | 33.0 | 34.2 | 35.4 | 36.7 | 37.9 | 39.1 | 40.4 | 41.6 | 42.9 | 44.2 | 45.4 |
| 15 | 17.5 | 18.7 | 19.9 | 21.1 | 22.3 | 23.5 | 24.7 | 25.9 | 27.2 | 28.4 | 29.6 | 30.8 | 32.1 | 33.3 | 34.5 | 35.8 | 37.1 | 38.4 | 39.6 | 40.9 | 42.2 | 43.4 | 44.7 | 46.0 | 47.3 |
| 16 | 18.9 | 20.1 | 21.3 | 22.6 | 23.8 | 25.0 | 26.2 | 27.5 | 28.7 | 30.0 | 31.2 | 32.5 | 33.7 | 35.0 | 36.3 | 37.5 | 38.8 | 40.1 | 41.4 | 42.7 | 44.0 | 45.3 | 46.6 | 47.9 | 49.2 |
| 17 | 20.3 | 21.6 | 22.8 | 24.1 | 25.3 | 26.6 | 27.9 | 29.1 | 30.3 | 31.6 | 32.9 | 34.1 | 35.4 | 36.7 | 38.0 | 39.3 | 40.6 | 41.9 | 43.2 | 44.5 | 45.8 | 47.2 | 48.5 | 49.8 | 51.2 |
| 18 | 21.8 | 23.1 | 24.3 | 25.6 | 26.9 | 28.1 | 29.4 | 30.7 | 32.0 | 33.3 | 34.5 | 35.9 | 37.2 | 38.5 | 39.8 | 41.1 | 42.4 | 43.8 | 45.1 | 46.5 | 47.8 | 49.2 | 50.5 | 51.9 | 53.2 |
| 19 | 23.3 | 24.6 | 25.9 | 27.2 | 28.5 | 29.8 | 31.1 | 32.4 | 33.7 | 35.0 | 36.3 | 37.6 | 39.0 | 40.3 | 41.6 | 43.0 | 44.3 | 45.7 | 47.1 | 48.4 | 49.8 | 51.2 | 52.6 | 54.0 | 55.4 |
| 20 | 24.9 | 26.2 | 27.5 | 28.8 | 30.1 | 31.5 | 32.8 | 34.1 | 35.4 | 36.8 | 38.1 | 39.5 | 40.8 | 42.2 | 43.6 | 44.9 | 46.3 | 47.7 | 49.1 | 50.5 | 51.9 | 53.3 | 54.7 | 56.1 | 57.6 |
| 21 | 26.5 | 27.9 | 29.2 | 30.5 | 31.9 | 33.2 | 34.5 | 35.9 | 37.3 | 38.6 | 40.0 | 41.4 | 42.8 | 44.1 | 45.5 | 46.9 | 48.4 | 49.8 | 51.2 | 52.6 | 54.1 | 55.5 | 56.9 | 58.4 | 59.8 |
| 22 | 28.2 | 29.5 | 30.9 | 32.3 | 33.6 | 35.0 | 36.4 | 37.7 | 39.1 | 40.5 | 41.9 | 43.3 | 44.8 | 46.2 | 47.6 | 49.0 | 50.5 | 51.9 | 53.4 | 54.8 | 56.3 | 57.8 | 59.3 | 60.8 | 62.3 |
| 23 | 29.9 | 31.3 | 32.7 | 34.1 | 35.5 | 36.8 | 38.3 | 39.7 | 41.1 | 42.5 | 43.9 | 45.4 | 46.8 | 48.3 | 49.7 | 51.2 | 52.7 | 54.2 | 55.6 | 57.1 | 58.6 | 60.2 | 61.7 | 63.2 | 64.7 |
| 24 | 31.7 | 33.1 | 34.5 | 35.9 | 37.3 | 38.8 | 40.2 | 41.7 | 43.1 | 44.6 | 46.0 | 47.5 | 49.0 | 50.5 | 52.0 | 53.5 | 55.0 | 56.5 | 58.0 | 59.5 | 61.1 | 62.6 | 64.2 | 65.8 | 67.3 |
| 25 | 33.6 | 35.0 | 36.4 | 37.9 | 39.3 | 40.8 | 42.2 | 43.7 | 45.2 | 46.7 | 48.2 | 49.7 | 51.2 | 52.7 | 54.3 | 55.8 | 57.3 | 58.9 | 60.5 | 62.0 | 63.6 | 65.2 | 66.8 | 68.4 | 70.0 |
| 26 | 35.5 | 36.9 | 38.4 | 39.9 | 41.4 | 42.8 | 44.3 | 45.9 | 47.4 | 48.9 | 50.4 | 52.0 | 53.5 | 55.1 | 56.7 | 58.2 | 59.8 | 61.4 | 63.0 | 64.7 | 66.3 | 67.9 | 69.6 | 71.2 | 72.9 |
| 27 | 37.4 | 39.0 | 40.4 | 42.0 | 43.5 | 45.0 | 46.5 | 48.1 | 49.6 | 51.2 | 52.8 | 54.4 | 56.0 | 57.6 | 59.2 | 60.8 | 62.4 | 64.1 | 65.7 | 67.4 | 69.1 | 70.8 | 72.5 | 74.2 | 75.9 |
| 28 | 39.5 | 41.0 | 42.6 | 44.1 | 45.7 | 47.3 | 48.9 | 50.4 | 52.0 | 53.6 | 55.2 | 56.9 | 58.5 | 60.2 | 61.9 | 63.5 | 65.2 | 66.9 | 68.6 | 70.3 | 72.0 | 73.7 | 75.5 | 77.3 | 79.0 |
| 29 | 41.7 | 43.2 | 44.8 | 46.4 | 48.0 | 49.6 | 51.2 | 52.8 | 54.5 | 56.1 | 57.8 | 59.5 | 61.2 | 62.9 | 64.6 | 66.3 | 68.0 | 69.8 | 71.5 | 73.3 | 75.1 | 76.9 | 78.7 | 80.5 | 82.4 |
| 30 | 43.9 | 45.5 | 47.1 | 48.7 | 50.4 | 52.0 | 53.7 | 55.4 | 57.1 | 58.8 | 60.5 | 62.2 | 64.0 | 65.7 | 67.5 | 69.3 | 71.0 | 72.9 | 74.7 | 76.5 | 78.3 | 80.2 | 82.1 | 84.0 | 85.9 |
| 31 | 46.2 | 47.9 | 49.5 | 51.2 | 52.9 | 54.6 | 56.3 | 58.1 | 59.8 | 61.6 | 63.3 | 65.1 | 66.9 | 68.7 | 70.5 | 72.4 | 74.2 | 76.1 | 78.0 | 79.9 | 81.8 | 83.7 | 85.7 | 87.6 | 89.6 |
| 32 | 48.7 | 50.4 | 52.1 | 53.9 | 55.6 | 57.3 | 59.1 | 60.9 | 62.7 | 64.5 | 66.3 | 68.2 | 70.0 | 71.9 | 73.8 | 75.7 | 77.6 | 79.5 | 81.5 | 83.5 | 85.4 | 87.5 | 89.5 | 91.5 | 93.6 |
| 33 | 51.2 | 53.0 | 54.8 | 56.6 | 58.3 | 60.2 | 62.0 | 63.8 | 65.7 | 67.6 | 69.5 | 71.4 | 73.3 | 75.2 | 77.2 | 79.2 | 81.2 | 83.2 | 85.2 | 87.3 | 89.3 | 91.4 | 93.6 | 95.7 | 97.8 |
| 34 | 53.9 | 55.7 | 57.6 | 59.4 | 61.3 | 63.1 | 65.0 | 67.0 | 68.9 | 70.8 | 72.8 | 74.8 | 76.8 | 78.8 | 80.8 | 82.9 | 85.0 | 87.1 | 89.2 | 91.4 | 93.5 | 95.7 | 97.9 | 100.2 | 102.4 |
| 35 | 56.9 | 58.8 | 60.6 | 62.4 | 64.4 | 66.3 | 68.3 | 70.3 | 72.3 | 74.3 | 76.3 | 78.4 | 80.5 | 82.6 | 84.7 | 86.9 | 89.1 | 91.3 | 93.5 | 95.7 | 98.0 | 100.3 | 102.6 | 105.0 | 107.3 |
| 36 | 59.8 | 61.7 | 63.7 | 65.7 | 67.7 | 69.7 | 71.7 | 73.8 | 75.9 | 78.0 | 80.1 | 82.3 | 84.5 | 86.7 | 88.9 | 91.2 | 93.5 | 95.8 | 98.1 | 100.5 | 102.9 | 105.3 | 107.7 | 110.2 | 112.7 |
| 37 | 62.9 | 65.0 | 67.0 | 69.1 | 71.2 | 73.3 | 75.4 | 77.6 | 79.8 | 82.0 | 84.2 | 86.5 | 88.8 | 91.1 | 93.4 | 95.8 | 98.2 | 100.6 | 103.1 | 105.6 | 108.1 | 110.7 | 113.3 | 115.9 | 118.6 |
| 38 | 66.3 | 68.4 | 70.6 | 72.7 | 74.9 | 77.1 | 79.4 | 81.6 | 83.9 | 86.2 | 88.6 | 91.0 | 93.4 | 95.8 | 98.3 | 100.8 | 103.4 | 105.9 | 108.6 | 111.2 | 113.9 | 116.6 | 119.4 | 122.2 | 125.0 |
| 39 | 70.0 | 72.2 | 74.4 | 76.7 | 78.9 | 81.3 | 83.6 | 86.0 | 88.4 | 90.9 | 93.4 | 95.9 | 98.4 | 101.0 | 103.6 | 106.3 | 109.0 | 111.8 | 114.6 | 117.4 | 120.3 | 123.2 | 126.1 | 129.2 | 132.2 |
| 40 | 73.9 | 76.2 | 78.5 | 80.9 | 83.3 | 85.7 | 88.2 | 90.8 | 93.3 | 95.9 | 98.5 | 101.2 | 103.9 | 106.7 | 109.5 | 112.4 | 115.3 | 118.2 | 121.2 | 124.3 | 127.4 | 130.5 | 133.7 | 137.0 | 140.3 |
| 41 | 78.0 | 80.5 | 83.0 | 85.5 | 88.0 | 90.6 | 93.3 | 95.9 | 98.7 | 101.4 | 104.3 | 107.1 | 110.0 | 113.0 | 116.0 | 119.1 | 122.3 | 125.4 | 128.7 | 132.0 | 135.4 | 138.8 | 142.3 | 145.9 | 149.5 |
| 42 | 82.6 | 85.2 | 87.8 | 90.5 | 93.2 | 96.0 | 98.8 | 101.7 | 104.6 | 107.6 | 110.6 | 113.7 | 116.9 | 120.1 | 123.4 | 126.7 | 130.1 | 133.6 | 137.2 | 140.8 | 144.5 | 148.3 | 152.2 | 156.1 | 160.2 |
| 43 | 87.8 | 90.4 | 93.2 | 96.0 | 98.9 | 101.9 | 105.0 | 108.1 | 111.2 | 114.5 | 117.8 | 121.1 | 124.6 | 128.1 | 131.7 | 135.4 | 139.1 | 143.0 | 147.0 | 151.0 | 155.2 | 159.4 | 163.8 | 168.2 | 172.8 |
| 44 | 93.1 | 96.1 | 99.1 | 102.2 | 105.4 | 108.6 | 111.9 | 115.3 | 118.7 | 122.3 | 125.9 | 129.6 | 133.4 | 137.4 | 141.4 | 145.6 | 149.7 | 154.1 | 158.5 | 163.1 | 167.8 | 172.7 | 177.7 | 182.9 | 188.2 |
| 45 | 99.3 | 102.5 | 105.8 | 109.2 | 112.6 | 116.2 | 119.8 | 123.6 | 127.4 | 131.4 | 135.4 | 139.6 | 143.9 | 148.3 | 152.9 | 157.6 | 162.4 | 167.4 | 172.6 | 178.0 | 183.5 | 189.2 | 195.1 | 201.2 | 207.5 |
| 46 | 106.3 | 109.8 | 113.4 | 117.2 | 121.0 | 125.0 | 129.1 | 133.3 | 137.6 | 142.1 | 146.7 | 151.5 | 156.5 | 161.6 | 167.0 | 172.5 | 178.2 | 184.2 | 190.4 | 196.9 | 203.5 | 210.5 | 217.6 | 225.4 | 233.3 |
| 47 | 114.3 | 118.3 | 122.4 | 126.6 | 130.9 | 135.4 | 140.1 | 145.0 | 150.0 | 155.3 | 160.7 | 166.4 | 172.3 | 178.5 | 185.0 | 191.8 | 198.9 | 206.4 | 214.2 | 222.4 | 231.0 | 240.0 | 249.5 | 259.5 | 270.0 |
| 48 | 123.9 | 128.4 | 133.1 | 137.9 | 143.0 | 148.3 | 153.9 | 159.7 | 165.8 | 172.2 | 178.8 | 185.8 | 193.1 | 200.7 | 208.7 | 217.0 | 225.8 | 235.0 | 244.8 | 255.0 | 265.8 | 277.2 | 289.1 | 301.7 | 314.9 |
| 49 | 135.5 | 140.8 | 146.4 | 152.3 | 158.5 | 165.0 | 172.0 | 179.3 | 187.2 | 195.6 | 204.6 | 214.3 | 224.7 | 235.9 | 248.1 | 261.3 | 275.6 | 290.9 | 307.6 | 325.5 | 344.8 | 365.4 | 387.3 | 410.6 | 435.2 |

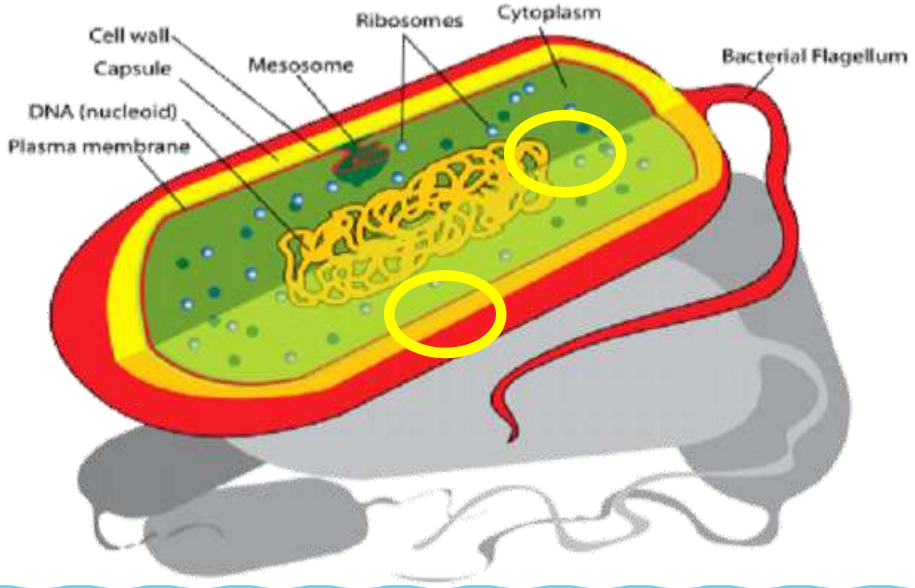
09-83235-01

# Microorganisms Removal

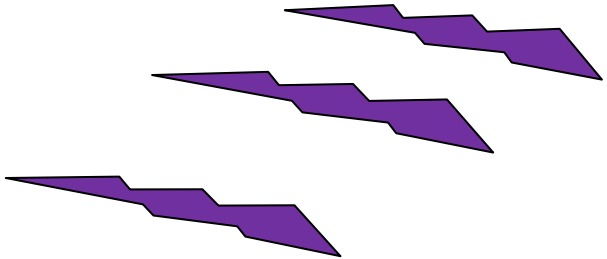
# Disinfection from the microbial perspective

inactivation of microorganisms during disinfection may be due to:

- **Disruption of cell wall** ⇒ structural deterioration of cell
- **Diffusion of oxidant into cell** ⇒ disruption of vital functions
- **Absorption of UV light** by cellular constituents (e.g., DNA)




Oxidant



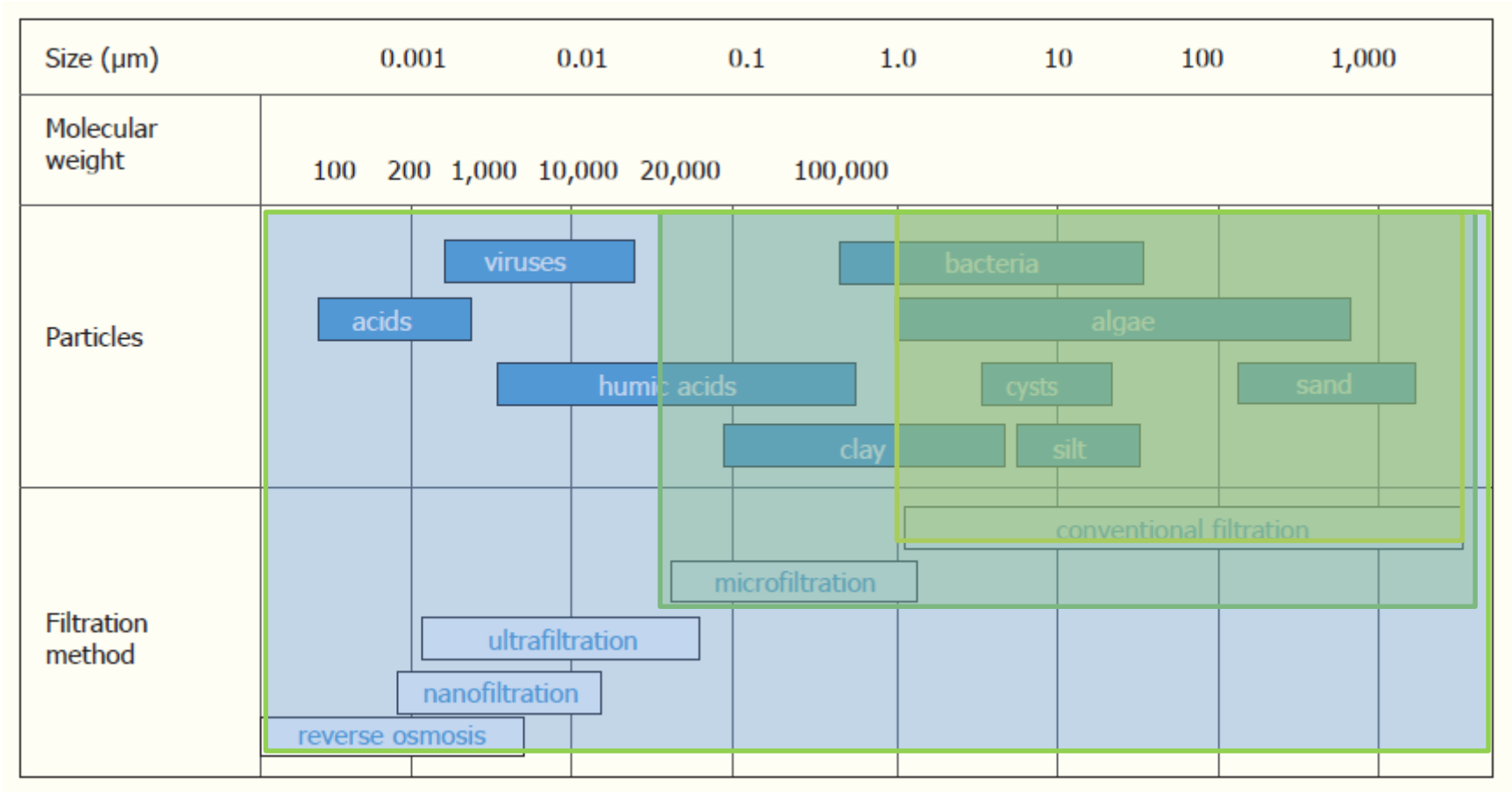
Oxidant

# Some treatment processes are more appropriate for certain pathogens than others

| Treatment Process | Microorganisms | | |
|---|---|---|---|
| | Viruses | Bacteria | Protozoans |
| Free chlorine | Very effective | Very effective | Less effective |
| Chlorine dioxide | Effective | Very effective | Effective |
| Iodine | Effective | Effective | Not effective |
| UV light | Effective | Very effective | Very effective |
| Natural sunlight | Effective | Effective | Less effective |
| Boiling | Very effective | Very effective | Very effective |
| Membrane Filtration | Variably effective | Very effective | Very effective |

*For more details see: http://www.sodis.ch/methode/forschung/mikrobio/index_EN and http://www.cdc.gov/healthywater/drinking/travel/backcountry_water_treatment.html

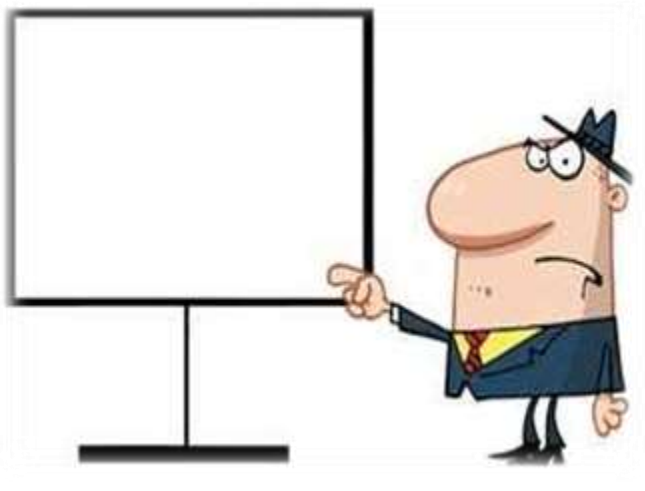
# Microorganisms Removal by Filtration



*any*
*questions...*

# خلاصة الدورة ..

**تعلمنا اليوم ..**

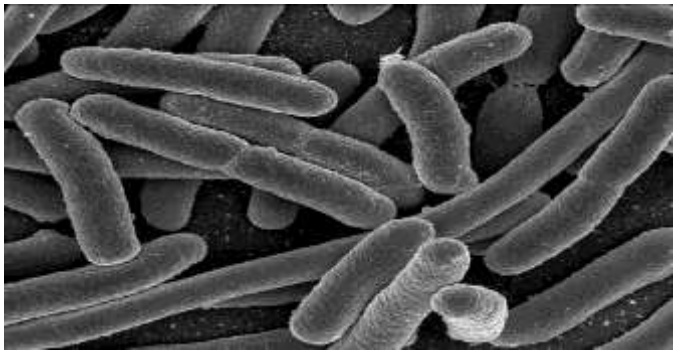
Understand ..
Not Memorize

Easy Come..
Easy Go ..

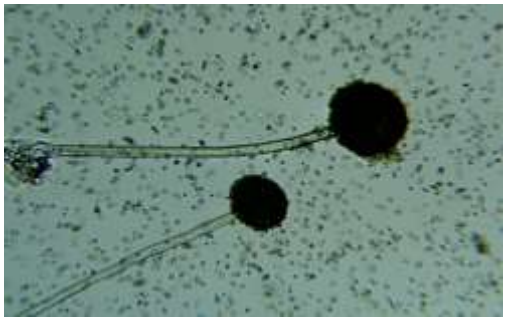
You..
Big Boss..

# Microbiology includes study of

Viruses

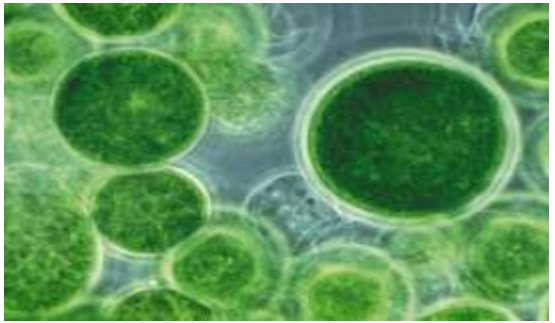


Bacteria



Fungi

Protozoa

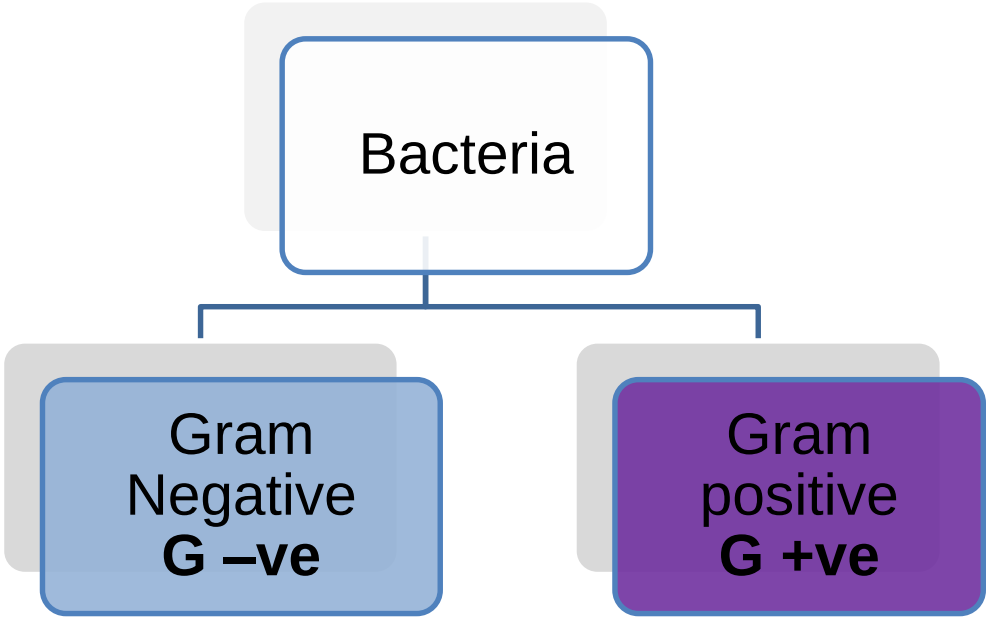


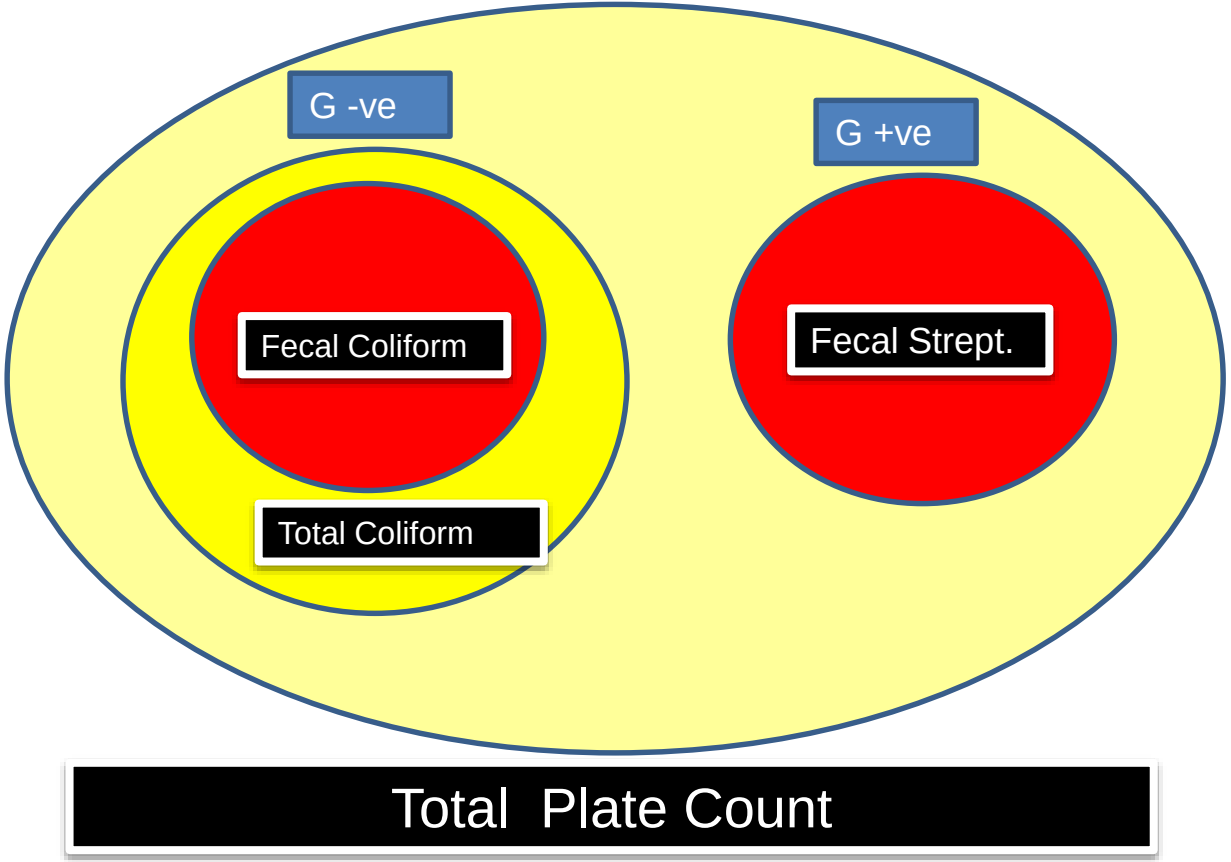
Algae

# Gram stain

## Hans Christian Gram

- The Gram stain was devised by the Danish physician, **Hans Christian Gram,** while working in Berlin in 1883. He later **published this procedure** in 1884. At the time, Dr. Gram was studying lung tissue sections from patients who had died of **pneumonia.**




G -ve
G +ve
Fecal Coliform
Fecal Strept.
Total Coliform
Total Plate Count

# Pour plate Method

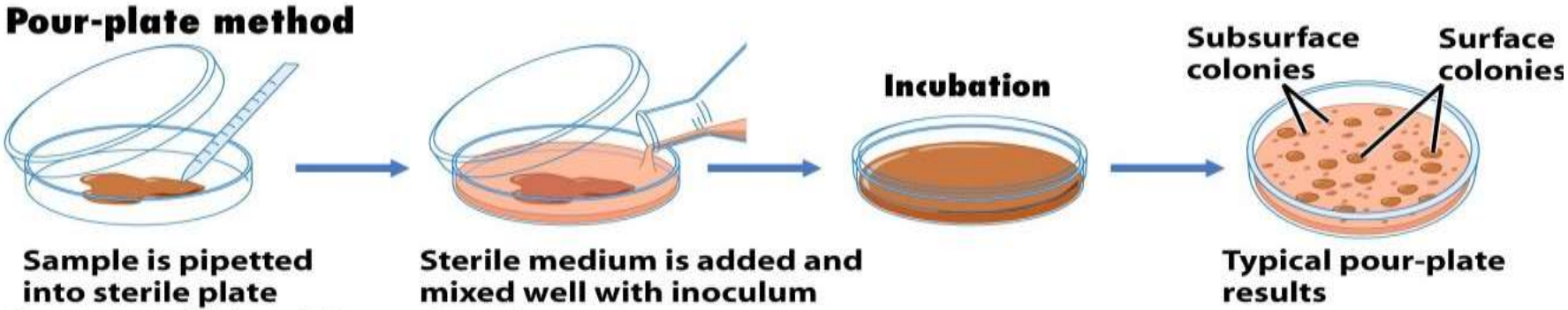
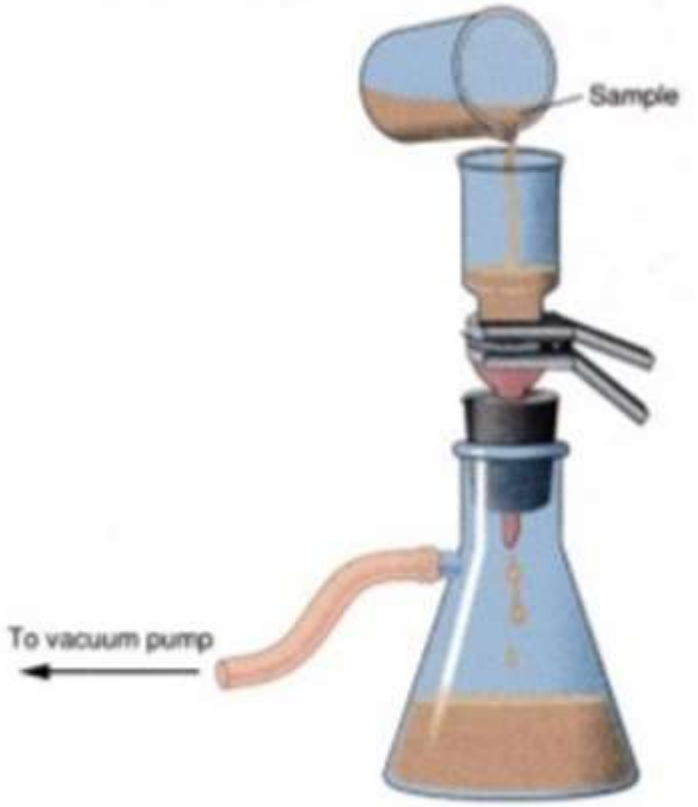
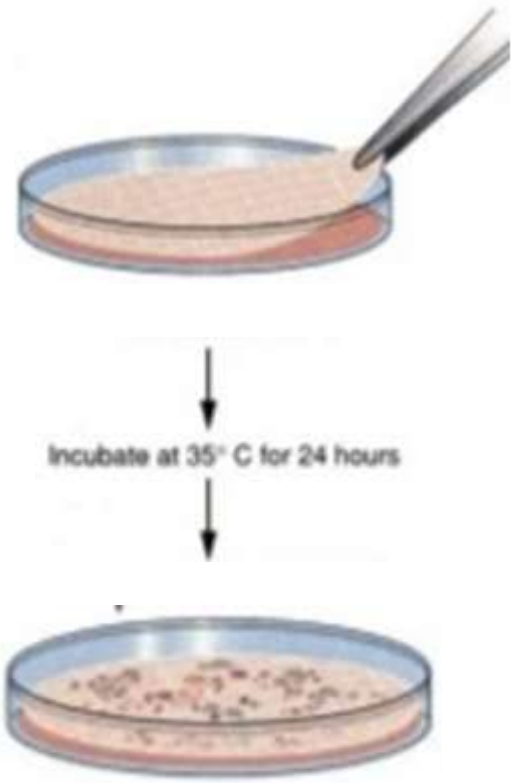



Figure 6-10 Brock Biology of Microorganisms 11/e

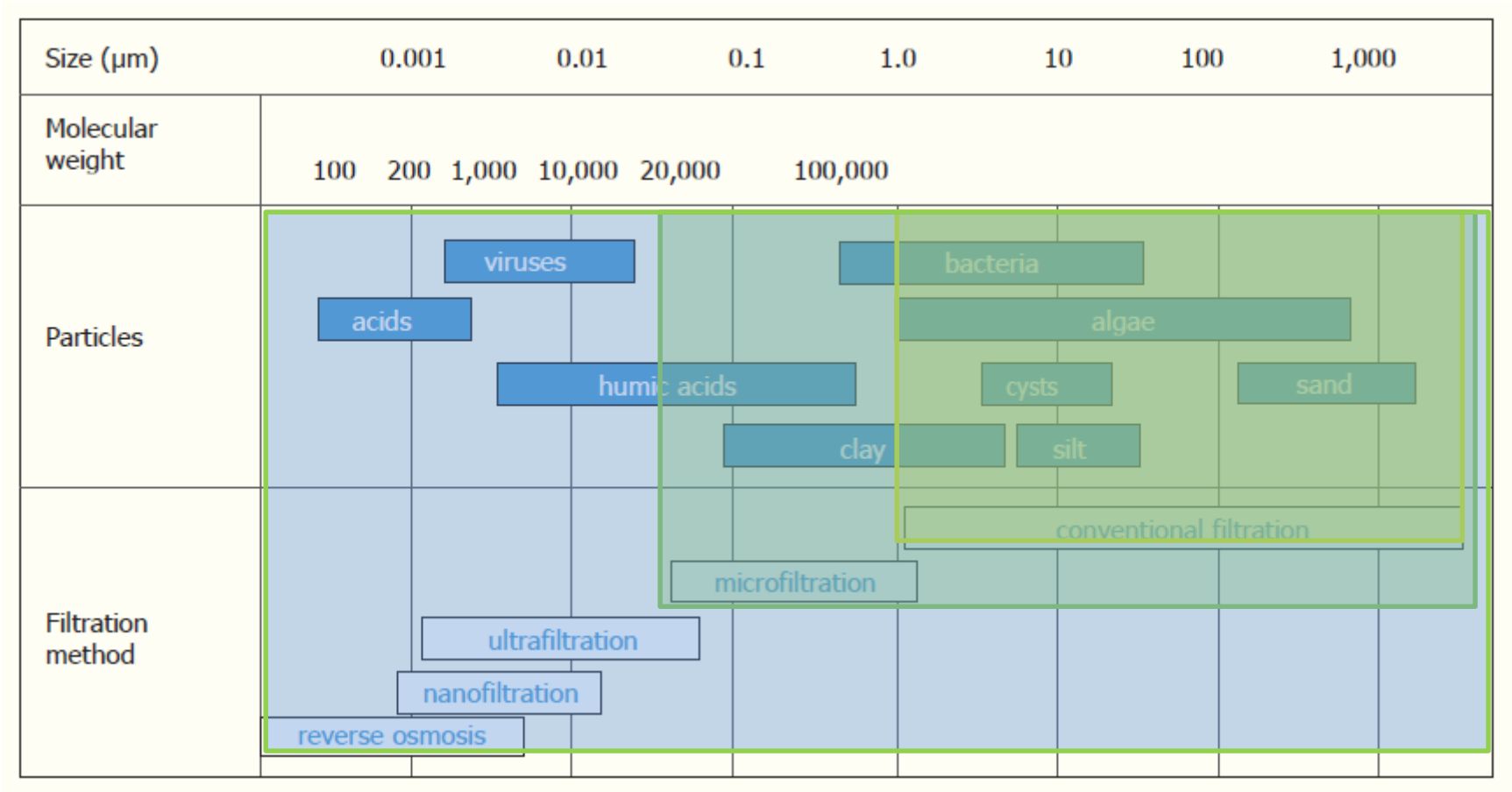
# Membrane Filter Technique



# Total Plate Count ( SimPlate® )

# Microorganisms Removal by Filtration



# Thank you ..

# keep in touch: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https://www.linkedin.com/in/**drHassan**

Facebook: Elhassan Elsadek

Facebook Page: **ميكروبيولوجيا المياه – الحسن الصادق**