



**UP**

**សាកលវិទ្យាល័យ ពុទ្ធិសាស្ត្រ**

**UNIVERSITY OF PUTHISAstra**

គោរពខ្លួនឯង

Honor Self

គោរពអ្នកដទៃ

Respect Others

អភិវឌ្ឍសង្គម

Develop Society

FACULTY OF MEDICINE

# MICROBIAL WORLD

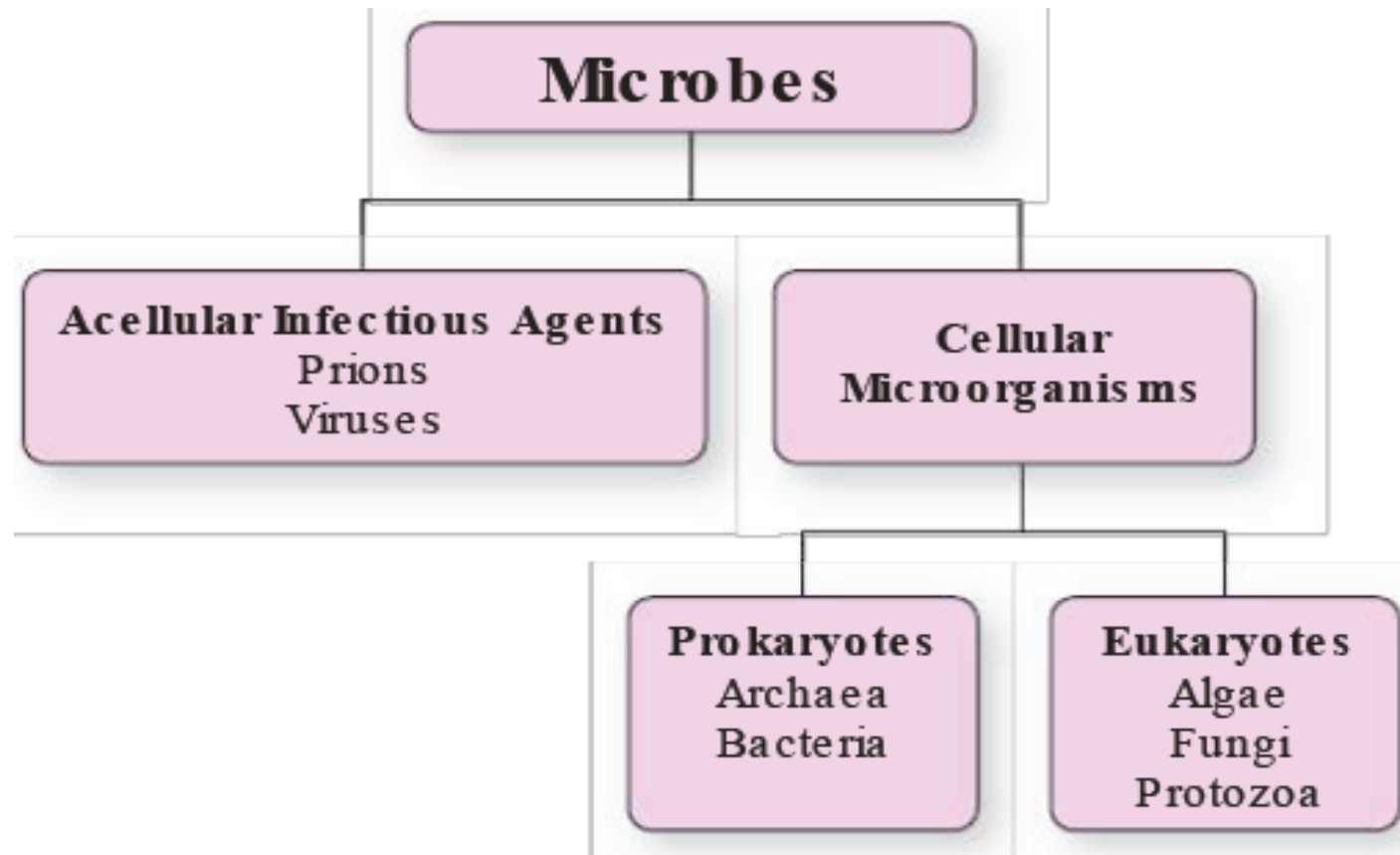
AN SRIM, MLT, MD

# Why Study Microbiology?

- ▶ They are very small, microbes play significant roles in our lives
- ▶ Living on and in our bodies (on our skin and in our mouths and intestinal tract),
- ▶ Approximately 10 times as many microbes as the total number of cells (epithelial cells, nerve cells, muscle cells, etc.)
- ▶ The microbes that live on and in the human body are referred to as our indigenous microbiota.
- ▶ Perhaps as many as 500 to 1,000 different species of microbes live on and in body
- ▶ Opportunistic pathogens do not cause disease under ordinary conditions , but have the potential to cause disease should the opportunity present itself.
- ▶ Pathogens cause two major types of diseases:
  - ▶ infectious diseases
  - ▶ microbial intoxications

# What is Microbiology?

- ▶ Microbiology is essentially an advanced biology course
- ▶ **Biology** is the study of *living* organisms



# Types of Microorganisms

## 1. Bacteria

- ▶ Are relatively simple, single-celled organisms.
- ▶ Because their genetic material is not enclosed in a special nuclear membrane, bacterial cells are called **prokaryotes**
- ▶ Bacterial cells generally appear in one of several shapes.
  - ▶ *Bacillus*
  - ▶ *coccus*
  - ▶ *spiral*
  - ▶ some bacteria are starshaped or square

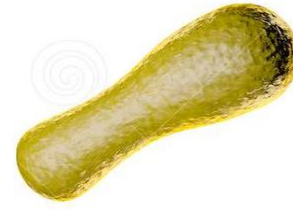




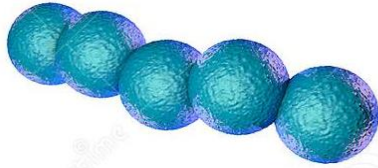
*Coccus*



*Diplococci*



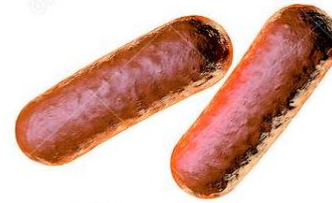
*Corynebacteria*



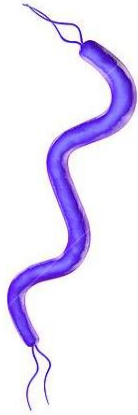
*Streptococci*



*Staphylococci*



*Bacillus*



*Spirilla*



*Spirochete*



*Vibrio*

## COCCI



**Diplococci**  
(*Streptococcus pneumoniae*)



**Streptococci**  
(*Streptococcus pyogenes*)

**Tetrad**



**Staphylococci**  
(*Staphylococcus aureus*)



**Sarcina**  
(*Sarcina ventriculi*)

## BACILLI



**Chain of bacilli**  
(*Bacillus anthracis*)



**Flagellate rods**  
(*Salmonella typhi*)



**Spore-former**  
(*Clostridium botulinum*)

## OTHERS



**Vibrios**  
(*Vibrio cholerae*)



**Spirilla**  
(*Helicobacter pylori*)

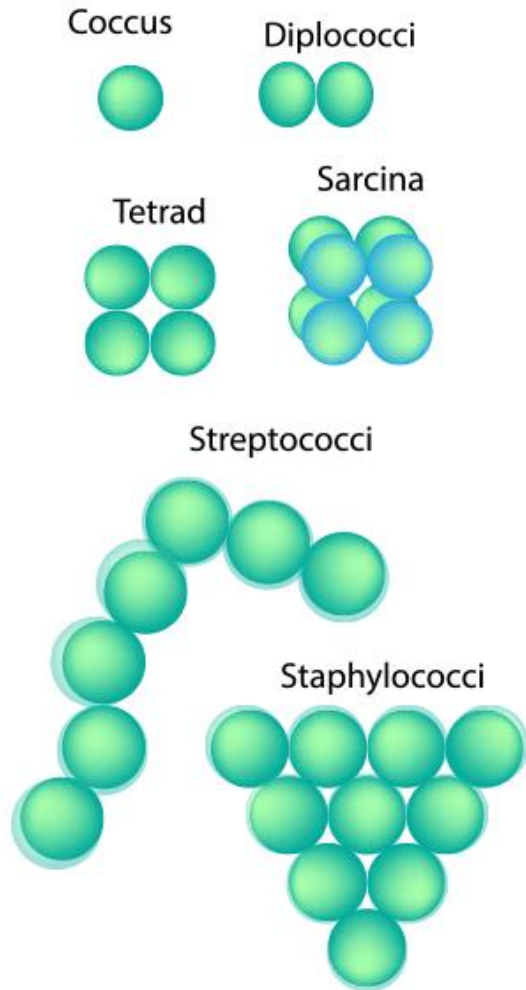


**Spirochaetes**  
(*Treponema pallidum*)

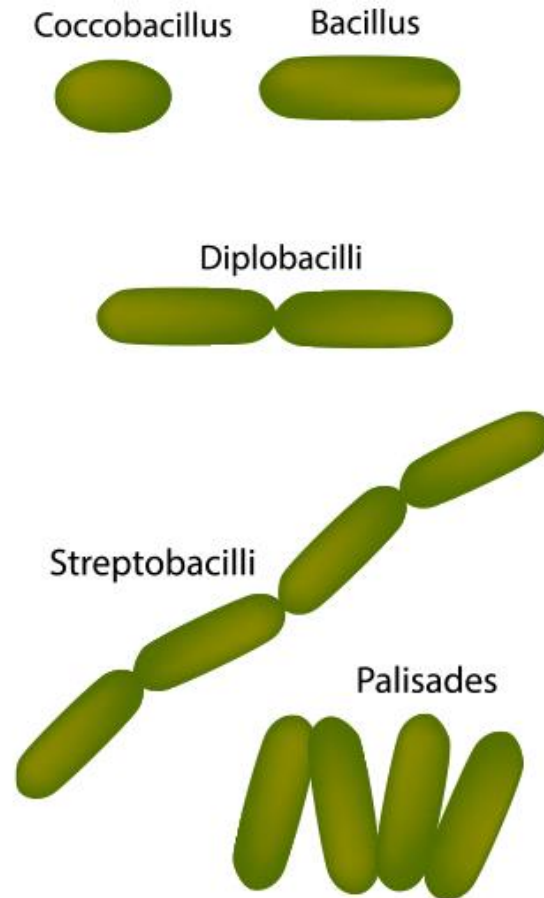
# 1. Bacteria

- ▶ Individual bacteria may form
  - ▶ pairs,
  - ▶ chains,
  - ▶ clusters,
  - ▶ or other groupings; such formations are usually characteristic of a particular genus or species of bacteria.

## Cocci



## Bacilli

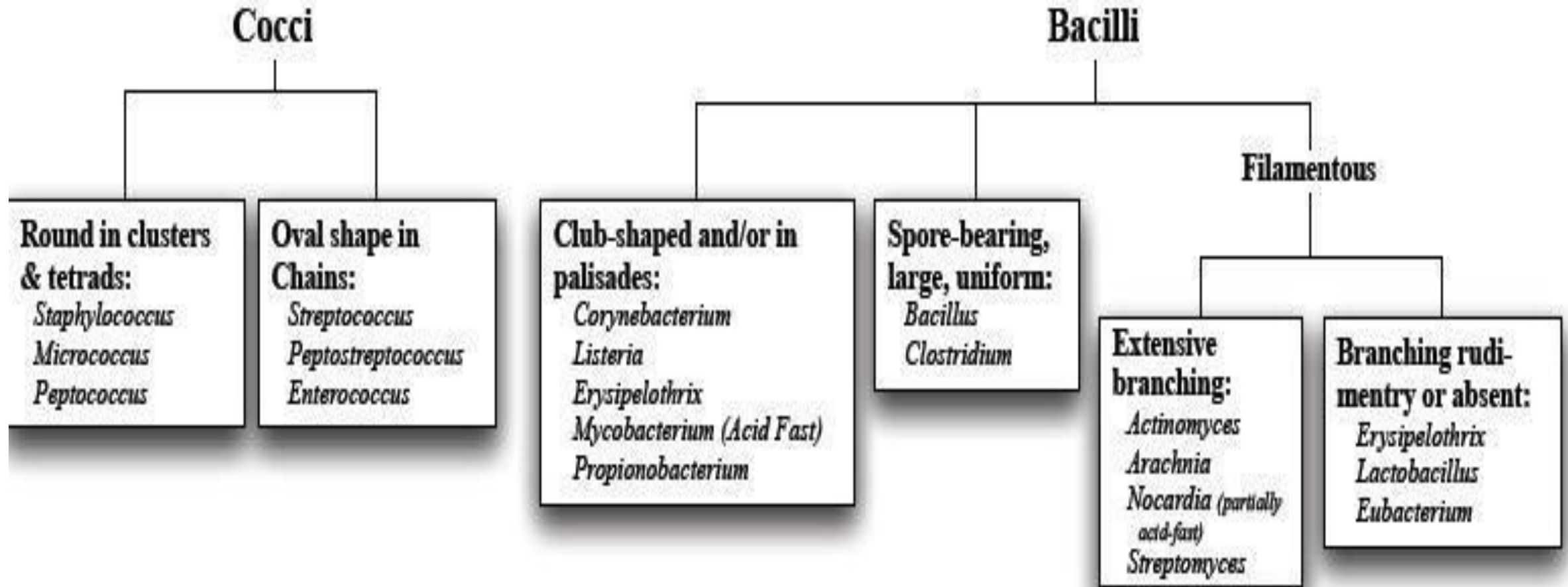


## Others





# Gram Positive

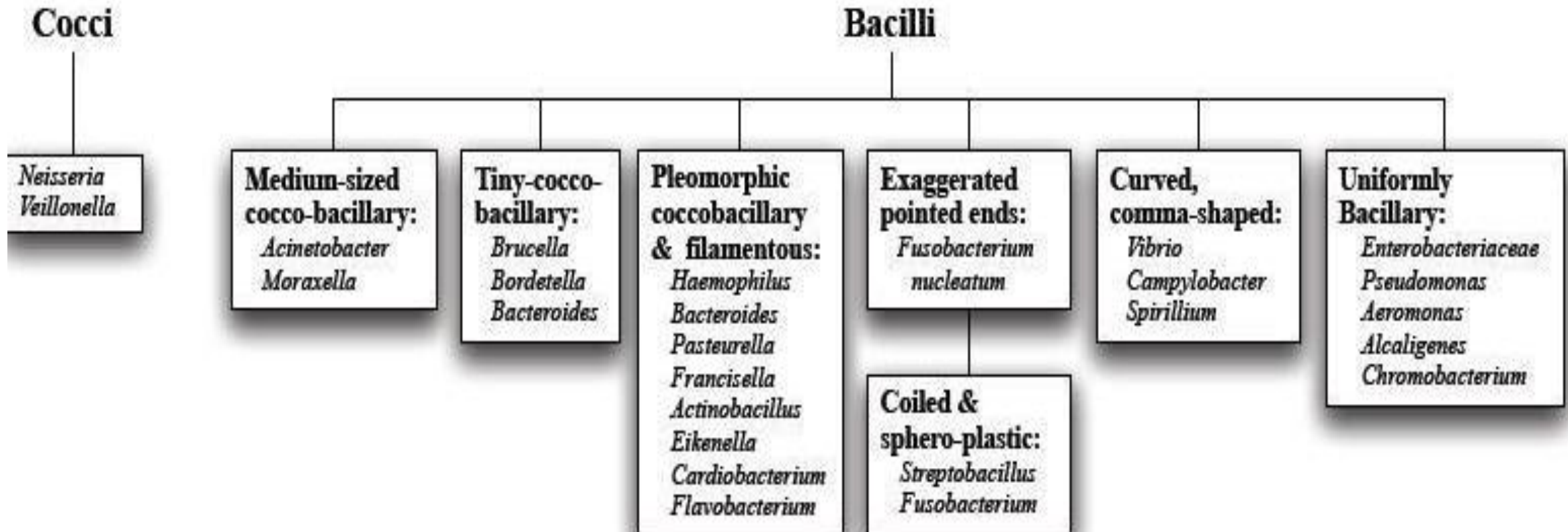


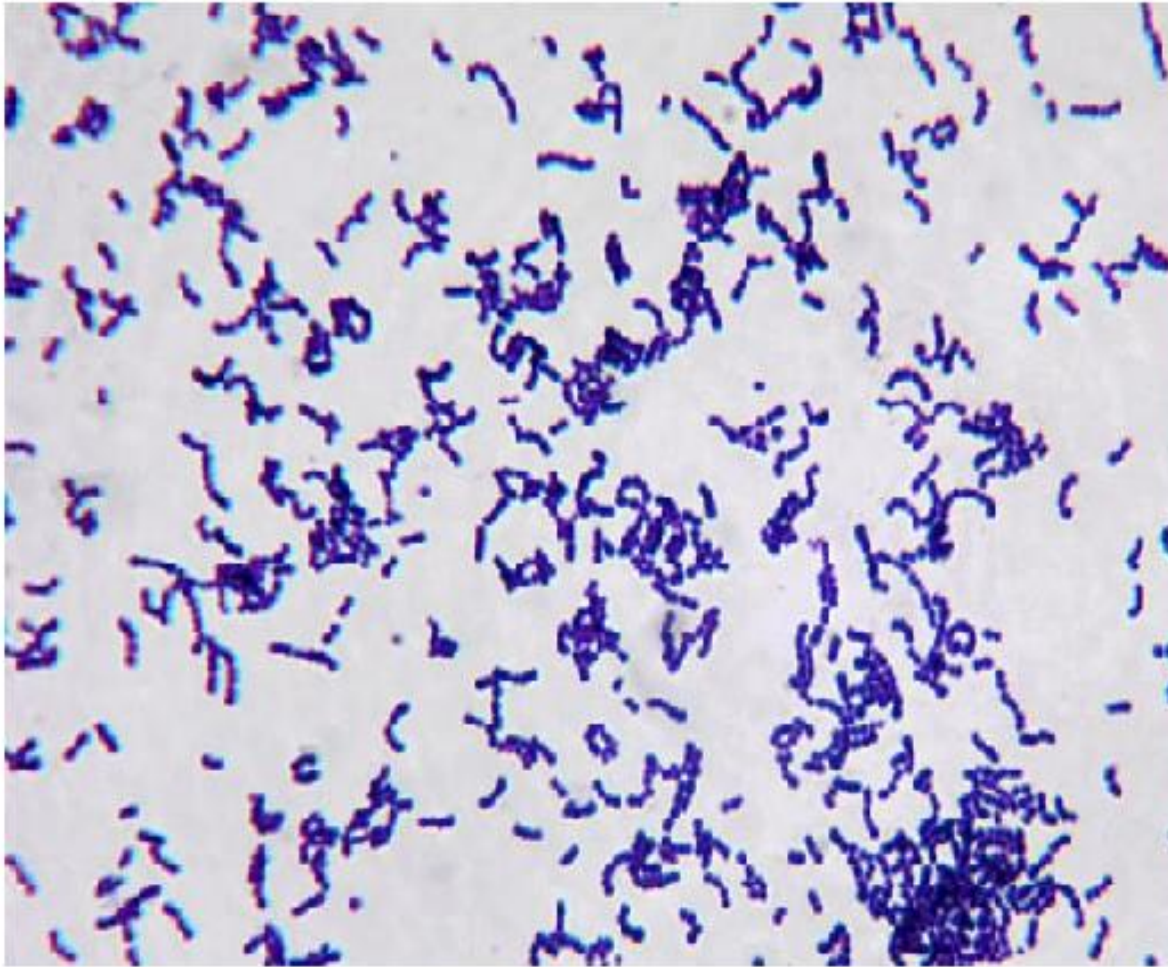
## Gram Positive Bacteria

## Gram Negative Bacteria

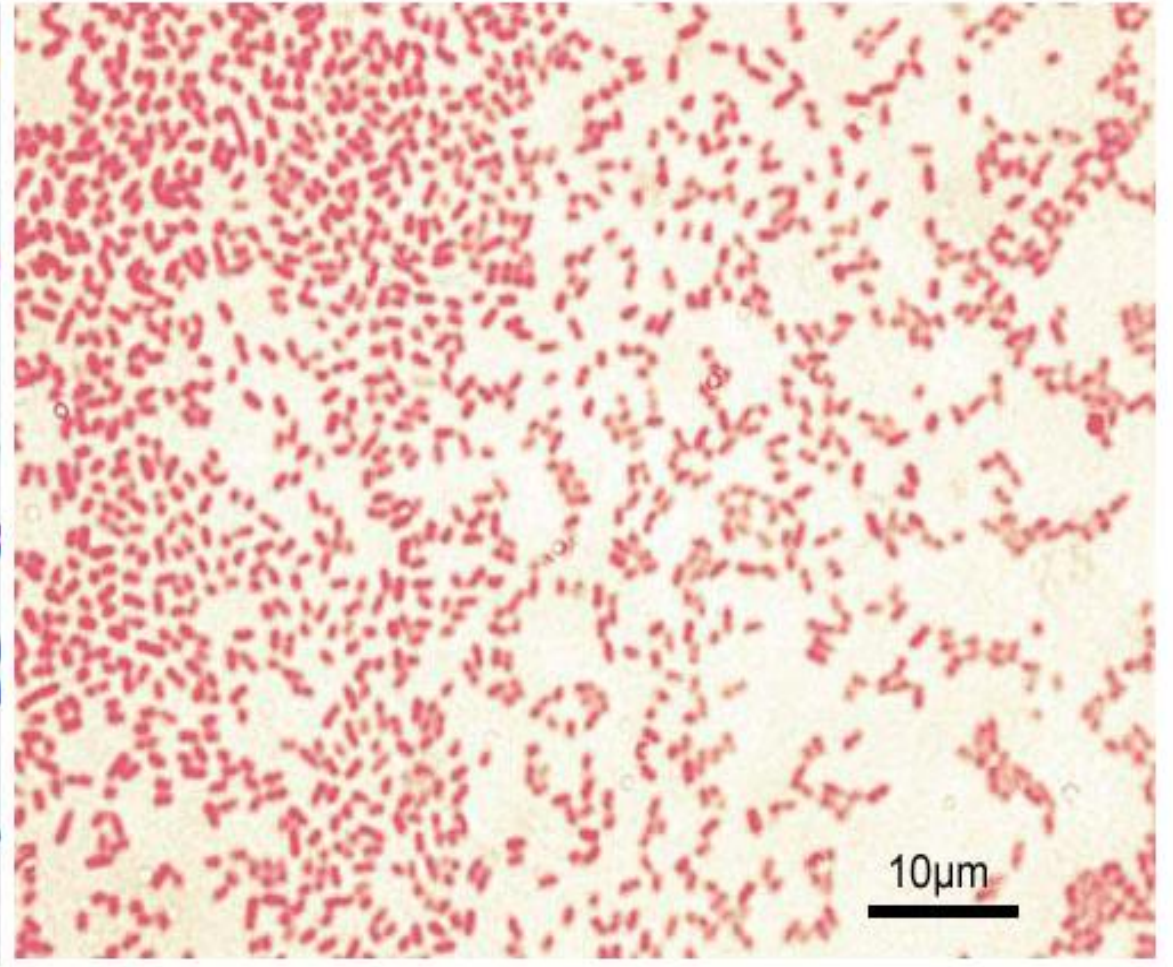


# Gram Negative





**Gram Positive Bacteria**



**Gram Negative Bacteria**

# Gram-Positive

cocci

bacilli  
*Corynebacterium*  
*Clostridium*  
*Listeria*  
*Bacillus*

*Staphylococcus*  
catalase+

*Streptococcus*  
catalase-

*S. aureus*  
coagulase+

coagulase--

*S. epidermidis*  
Novobiocin-sensitive

*S. saprophyticus*  
Novobiocin-resistant

$\beta$ -hemolytic  
(clear)

$\gamma$ -hemolytic

$\alpha$ -hemolytic  
(green)

*pyogenes*  
Group A,  
bacitracin-sensitive

*agalactiae*  
Group B,  
bacitracin-resistant

*Enterococcus*  
*E. faecalis*,  
*E. faecium*

*pneumoniae*  
optochin-sensitive,  
bile-soluble,  
capsule=>  
quellung+

Viridans  
*mutans*, *sanguis*  
optochin-resistant,  
not bile-soluble,  
no capsule

## 2. Fungi

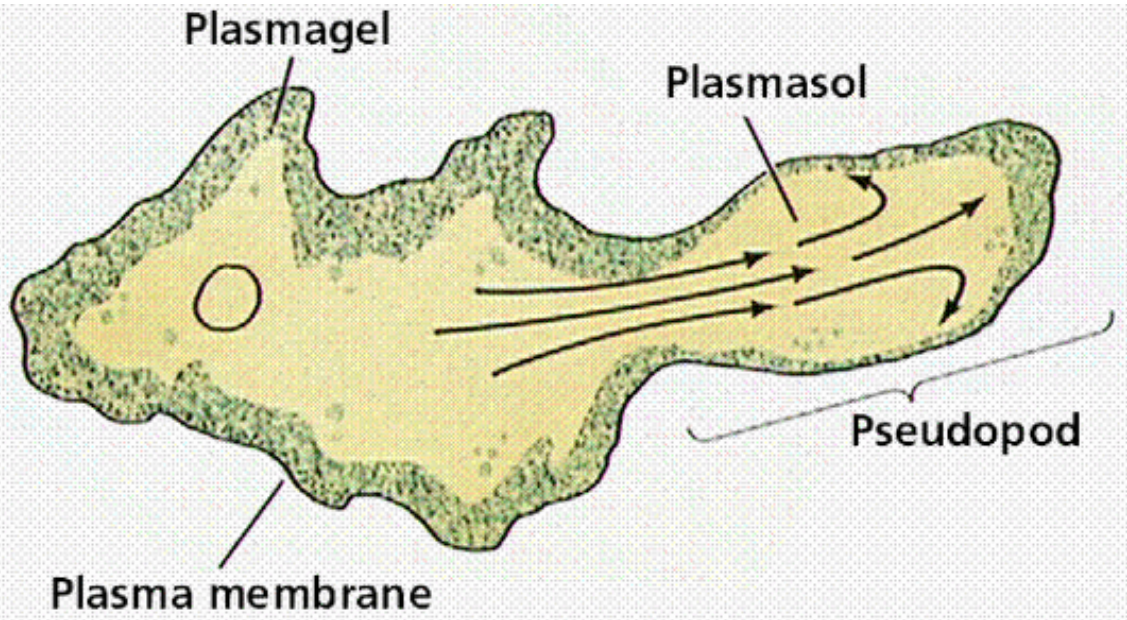
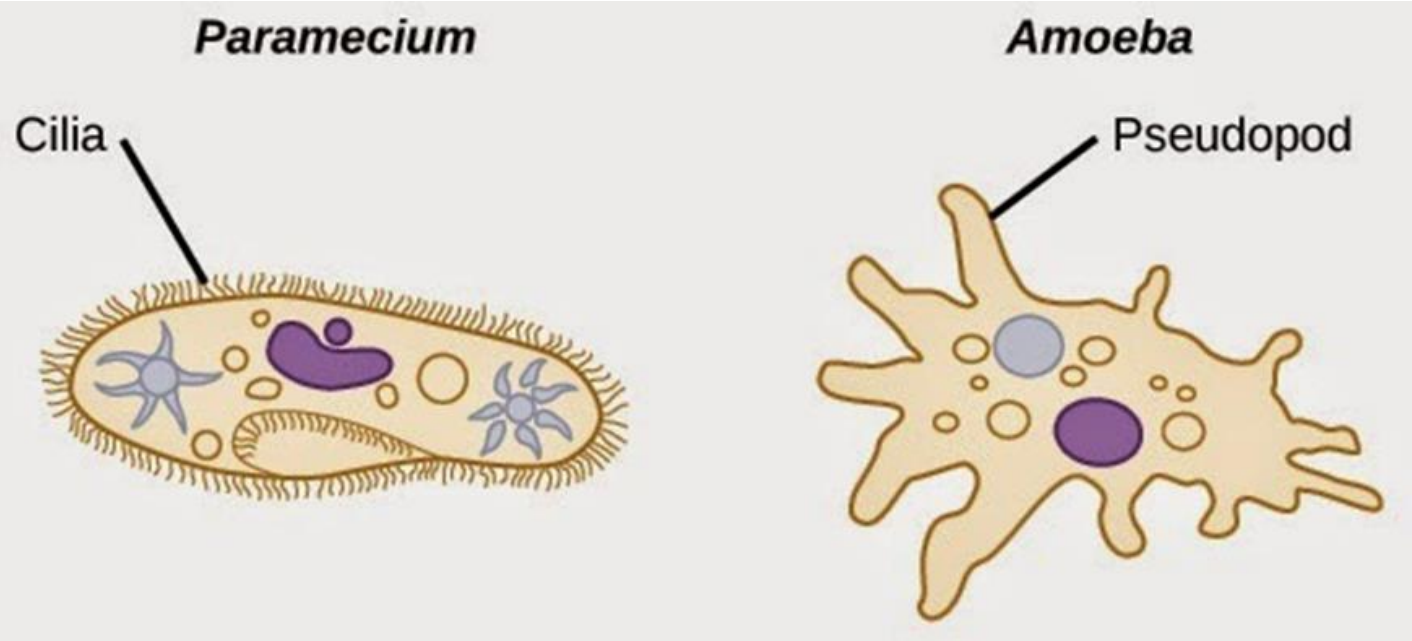
### 2. Fungi

- ▶ **Fungi** are **eukaryotes**, organisms whose cells have a distinct nucleus containing the cell's genetic material (DNA),
- ▶ surrounded by a special envelope called the nuclear membrane
- ▶ *Yeasts*
  - ▶ oval microorganisms
  - ▶ larger than bacteria
- ▶ **Molds**
  - ▶ form visible masses called *mycelia*,
  - ▶ which are composed of long filaments (*hyphae*) that branch and intertwine



### 3. Protozoa

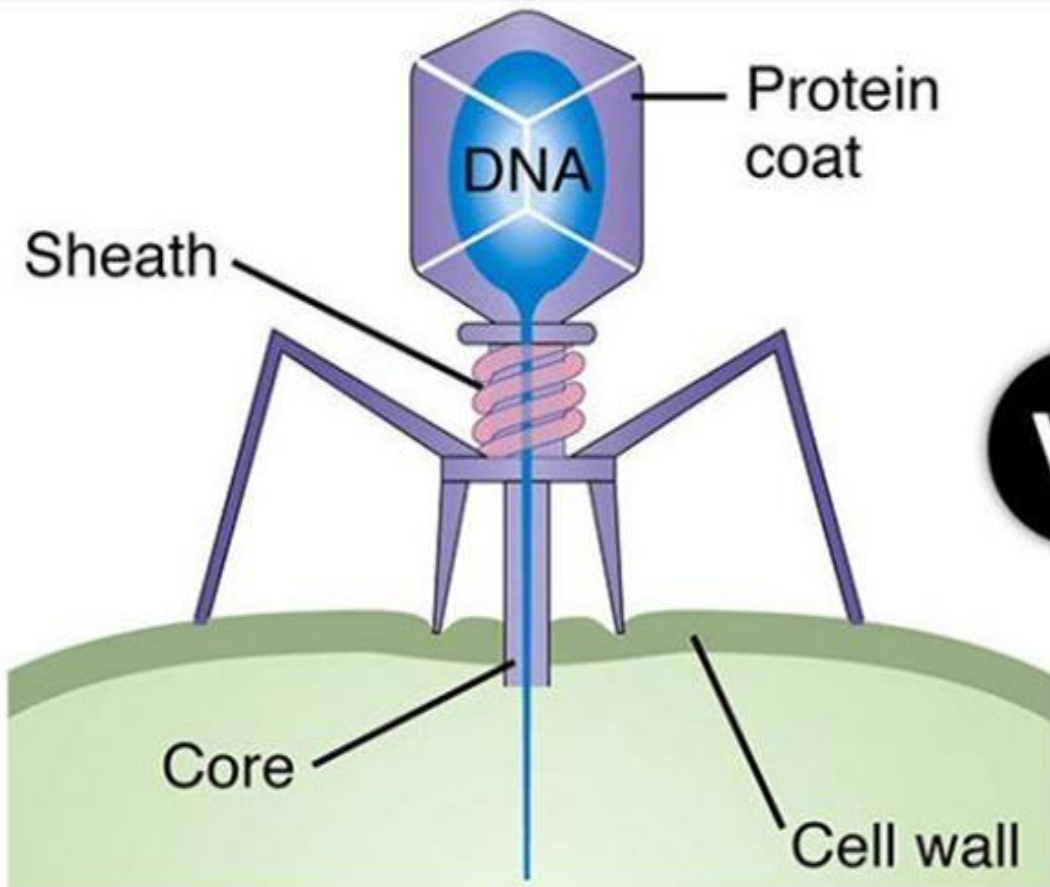
- ▶ Unicellular eukaryotic microbes
- ▶ Protozoa move by
  - ▶ pseudopods,
  - ▶ flagella, or cilia
- ▶ Amebae move by using extensions of their cytoplasm called *pseudopods* (false feet)
- ▶ Other protozoa have long *flagella*
- ▶ numerous shorter appendages for locomotion called *cilia*
- ▶ *Euglena* are photosynthetic: They use light as a source of energy and carbon dioxide as their chief source of carbon to produce sugars
- ▶ Protozoa can reproduce
  - ▶ sexually or
  - ▶ asexually



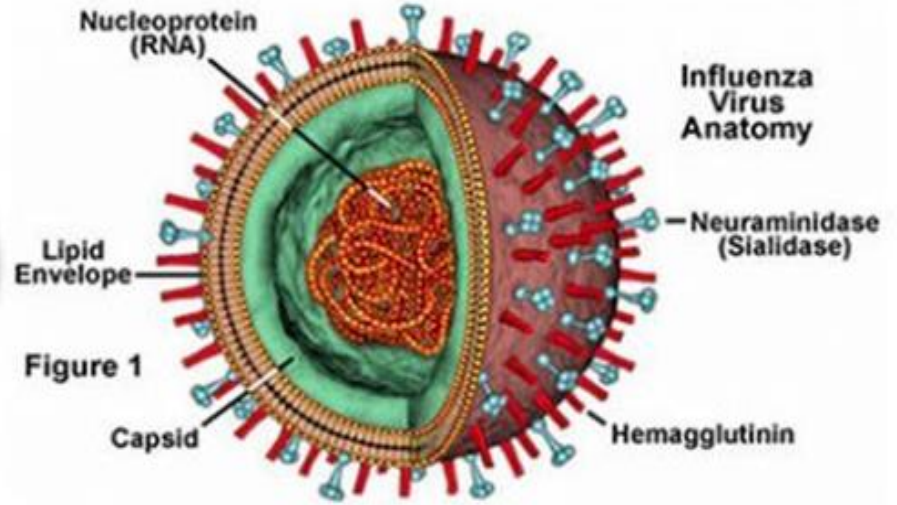


## 4. Viruses

- ▶ They are so small that most can be seen only with an electron microscope
- ▶ Acellular
- ▶ Structurally very simple
  - ▶ DNA virus
  - ▶ RNA virus
- ▶ core is surrounded by a protein coat,  
which is sometimes encased by a lipid membrane called an envelope
- ▶ Viruses can reproduce only by using the cellular machinery of other organisms



VS



# ***DNA Viruses vs. RNA Viruses***

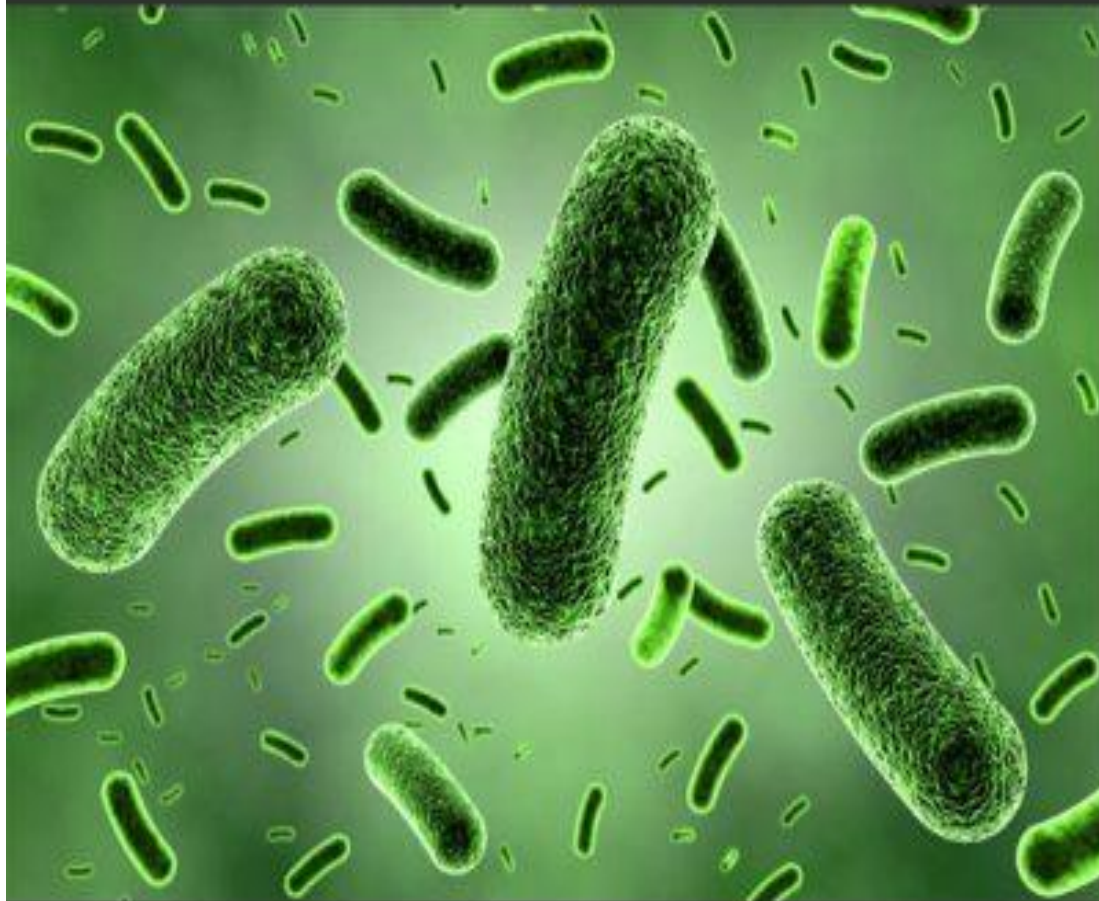
## 5. Archaea

- ▶ Like bacteria
- ▶ Consist of prokaryotic cells,
- ▶ If they have cell walls, the walls lack peptidoglycan.
- ▶ Often found in extreme environments
- ▶ Divided into three main groups.
  - ▶ *Methanogens* produce methane as a waste product from respiration
  - ▶ *Extreme halophiles* live in extremely salty environments such as the Great Salt Lake and the Dead Sea
  - ▶ *extreme thermophiles* live in hot sulfurous water, such as hot springs at Yellowstone National Park
- ▶ Archaea are not known to cause disease in humans

**BACTERIA**

**VS**

**ARCHAEA**



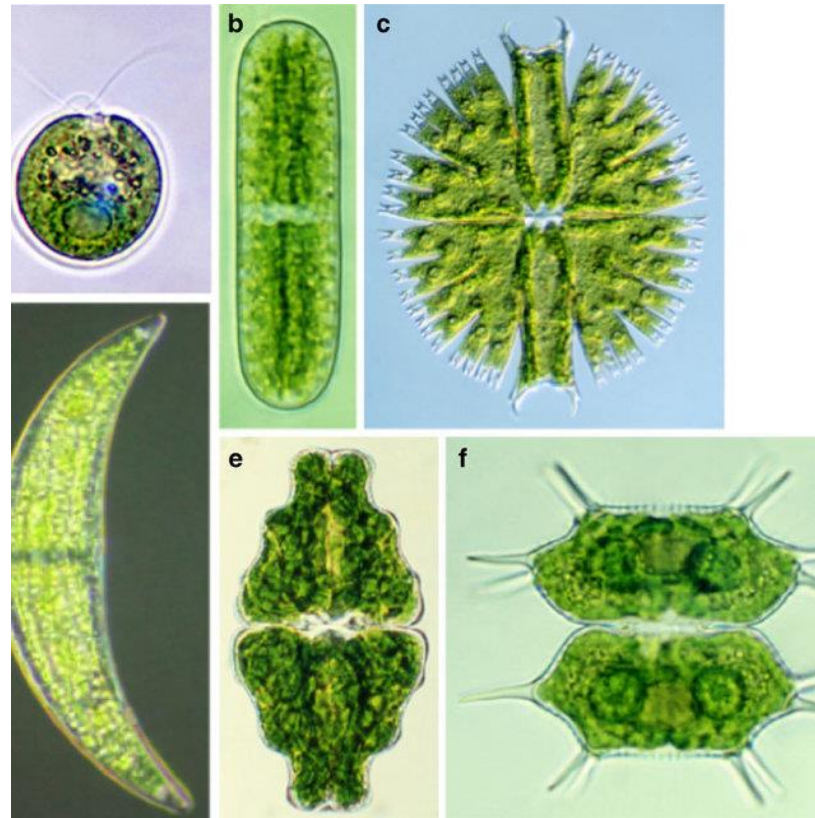
## 6. Algae

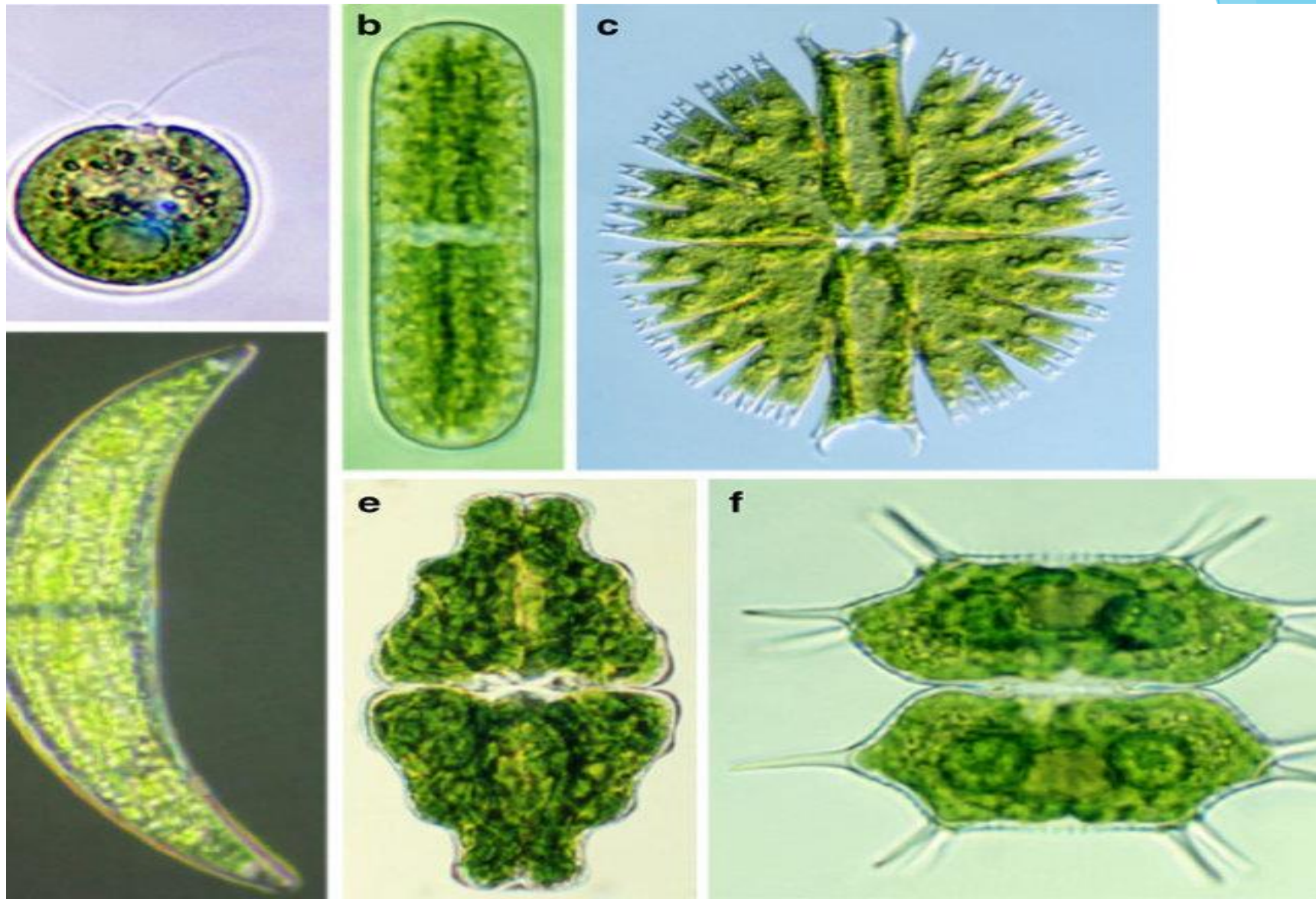
- ▶ Photosynthetic eukaryotes with a wide variety of shapes and both sexual and asexual reproductive forms
- ▶ Unicellular
- ▶ Cell walls of many algae are composed of a carbohydrate called *cellulose*
- ▶ Algae are abundant in freshwater and saltwater, in soil, and in association with plants
- ▶ Photo synthesizers: need light, water, and carbon dioxide for food production and growth

## 6. Algae

- ▶ Algae produce oxygen and carbohydrates that are then utilized by other organisms, including animals.
- ▶ They play an important role in the balance of nature
- ▶ Algae A very rare cause of infections , but they can cause intoxications (which result from ingestion of toxins )

Isolated green algae: a *Chlamydomonas*, b *Cylindrocapsa*, c *Micrasterias*, d *Closterium*, e *Euastrum*, f *Xanthidium*





► Isolated green algae: a *Chlamydomonas*, b *Cylindrocapsa*, c *Micrasterias*, d *Closterium*, e *Euastrum*, f *Xanthidium*

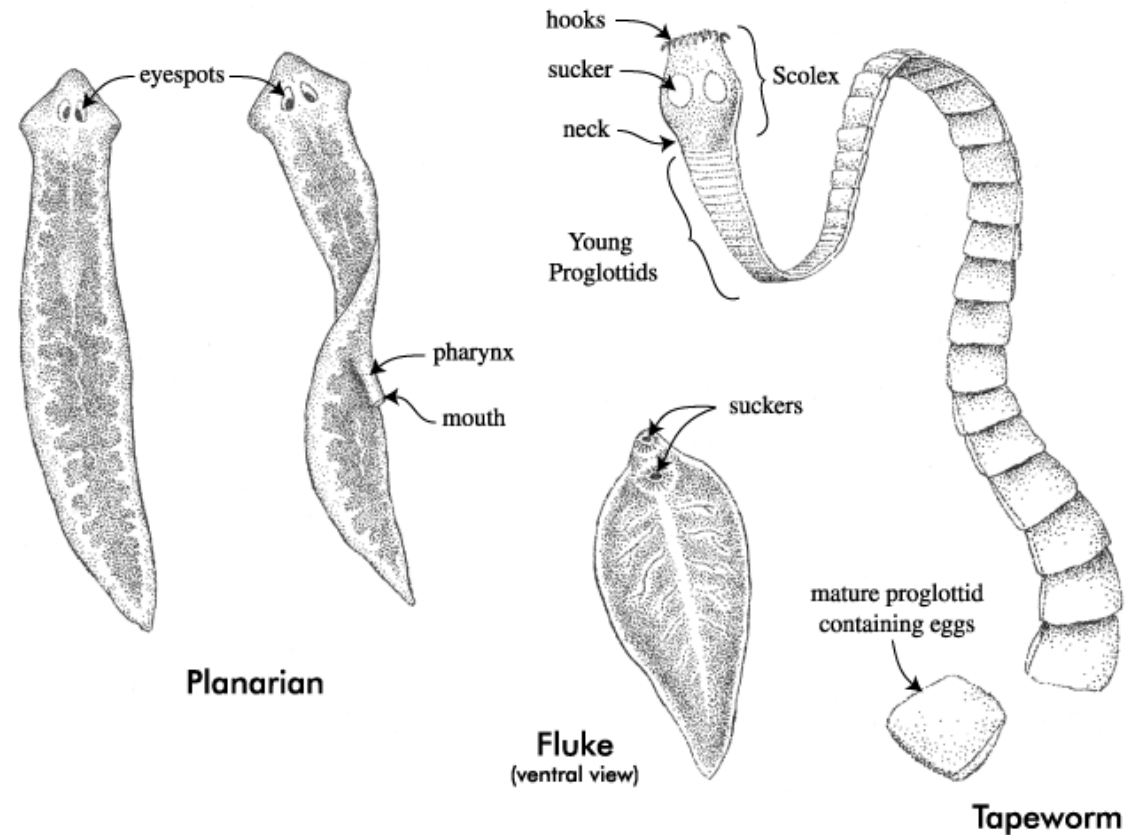


# 7. Multicellular Animal Parasites

- ▶ Animal parasites are eukaryotes
- ▶ The two major groups
  - ▶ flatworms
  - ▶ Roundworms



## FLATWORMS



# Classification of Microorganisms

- ▶ Classification based on the cellular organization of organisms. It groups all organisms in three domains as follows:
  1. Bacteria: cell walls contain a protein–carbohydrate complex called peptidoglycan
  2. Archaea: cell walls lack peptidoglycan (if present)
  3. Eukarya, which includes the following:
    - ▶ Protists: slime molds, protozoa, and algae
    - ▶ Fungi: unicellular yeasts, multicellular molds, and mushrooms
    - ▶ Plants: mosses, ferns, conifers, and flowering plants
    - ▶ Animals: sponges, worms, insects, and vertebrates

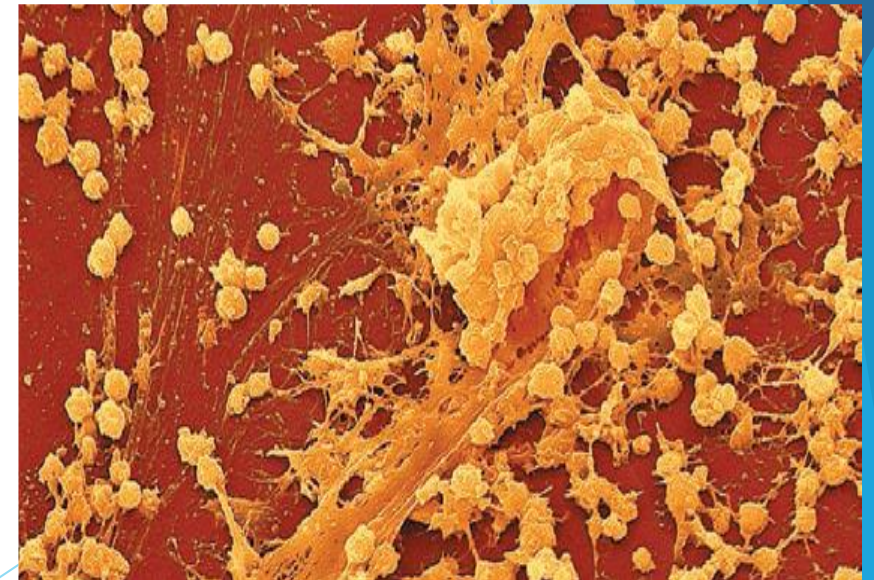
# Microbes and Human Disease

## 1. Normal Microbiota

- ▶ Protect us against disease by preventing the overgrowth of harmful microbes
- ▶ Produce useful substances such as vitamin K and some B vitamins
- ▶ Under some circumstances normal microbiota can make us sick or infect people we contact
- ▶ When some normal microbiota leave their habitat, they can cause disease
- ▶ **Resistance:** the ability to ward off diseases
- ▶ Resistance is provided by
  - ▶ barrier of the skin,
  - ▶ mucous membranes,
  - ▶ cilia,
  - ▶ stomach acid, and antimicrobial chemicals such as interferons

## 2. Biofilms

- ▶ Microorganisms may exist as single cells that float or swim independently in a liquid, or they may attach to each other and/or some usually solid surface
- ▶ They protect your mucous membranes from harmful microbes
- ▶ Biofilms can also be harmful
- ▶ They can clog water pipes, and on medical implants such as
  - ▶ joint prostheses
  - ▶ catheters
- ▶ they can cause such infections as endocarditis
- ▶ Bacteria in biofilms are often resistant to antibiotics because the biofilm offers a protective barrier



## 3. Infectious Diseases

- ▶ Malaria
- ▶ Cholera
- ▶ **Middle East respiratory syndrome (MERS)**
- ▶ **Severe acute respiratory syndrome (SARS)**
- ▶ **H1N1 influenza (flu)**
- ▶ **Avian influenza A (H5N1), or bird flu**
- ▶ tuberculosis (TB)
- ▶ **West Nile encephalitis (WNE)**

## **Infectious Disease**

A pathogen colonizes a person's body.

The pathogen causes a disease.

This type of disease is known as an infectious disease.

- Examples:
- MRSA infection
  - Gas gangrene

## **Microbial Intoxication**

A pathogen produces a toxin in vitro.

A person ingests the toxin. The toxin causes a disease.

This type of disease is known as a microbial intoxication.

- Examples:
- Staphylococcal food poisoning
  - Foodborne botulism

## Table 1-1 Pathogens

Category	Examples of Diseases They Cause
Algae	A very rare cause of infections, but they can cause intoxications (which result from ingestion of toxins)
Bacteria	Anthrax, botulism, cholera, diarrhea, diphtheria, ear and eye infections, food poisoning, gas gangrene, gonorrhea, hemolytic uremic syndrome (HUS), intoxications, Legionnaires disease, leprosy, Lyme disease, meningitis, plague, pneumonia, spotted fever, scarlet fever rickettsiosis, staph infections, strep throat, syphilis, tetanus, tuberculosis, tularemia, typhoid fever, typhus, urethritis, urinary tract infections, whooping cough
Fungi	Allergies, cryptococcosis, histoplasmosis, intoxications, meningitis, pneumonia, thrush, tinea (ringworm) infections, yeast vaginitis
Protozoa	African sleeping sickness, amebic dysentery, babesiosis, Chagas disease, cryptosporidiosis, diarrhea, giardiasis, malaria, meningoencephalitis, pneumonia, toxoplasmosis, trichomoniasis
Viruses	AIDS, "bird flu," certain types of cancer, chickenpox, cold sores (fever blisters), common cold, dengue, diarrhea, encephalitis, genital herpes infections, German measles, hantavirus pulmonary syndrome (HPS), hemorrhagic fevers, hepatitis, infectious mononucleosis, influenza, measles, meningitis, monkeypox, mumps, pneumonia, polio, rabies, severe acute respiratory syndrome (SARS), shingles, smallpox, "swine flu," warts, yellow fever

# References

- ▶ Microbiology An Introduction [Tortora] -12E (2016)
- ▶ Burton's Microbiology for the Health Sciences, 10e (Sep 11, 2014)