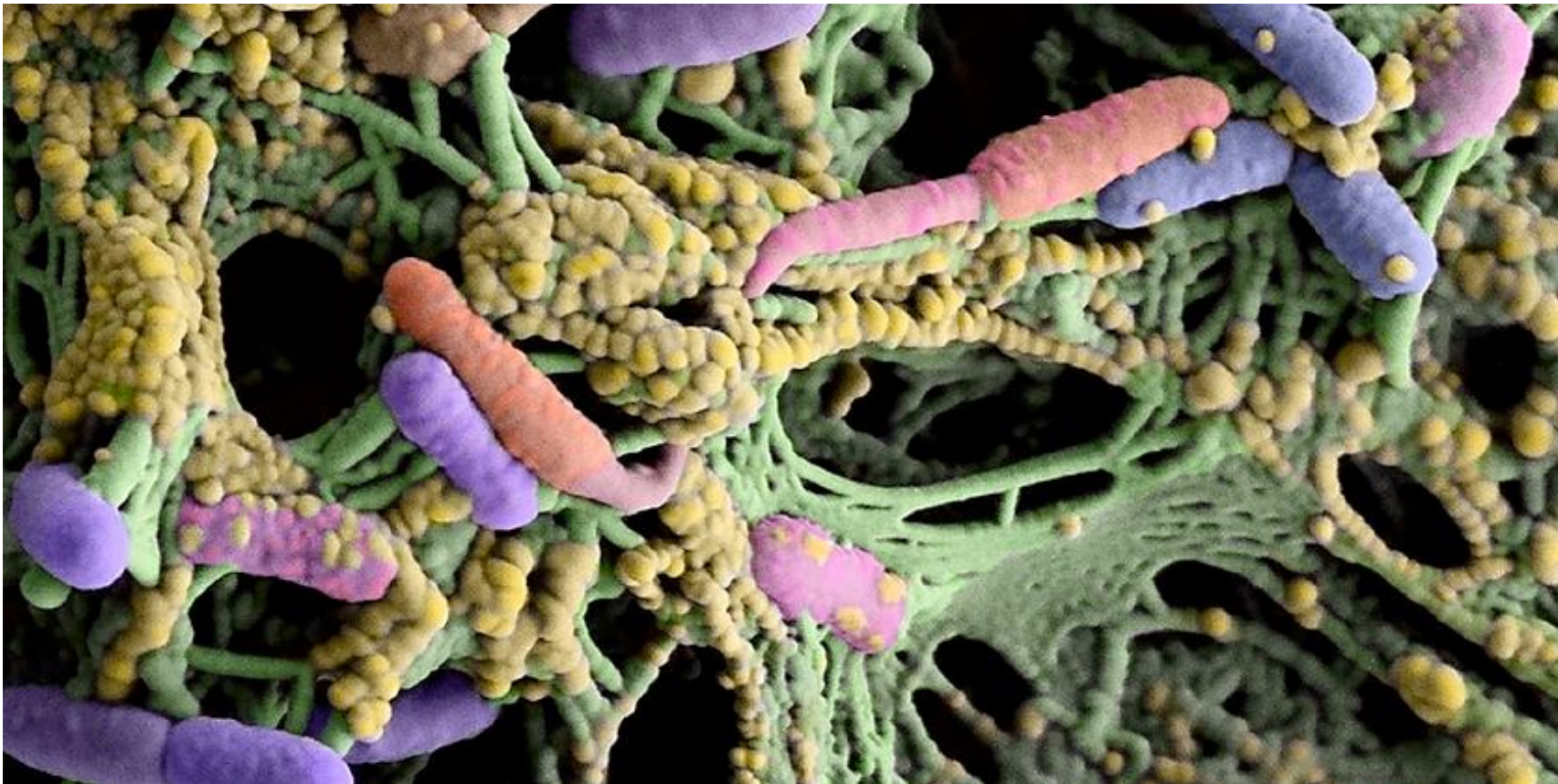


# CHAPTER 2.0

## ENVIRONMENTAL MICROBIOLOGY



# MICROORGANISMS THAT PLAY AN IMPORTANT ROLE IN ENVIRONMENTAL ENGINEERING ARE:

Bacteria

Viruses

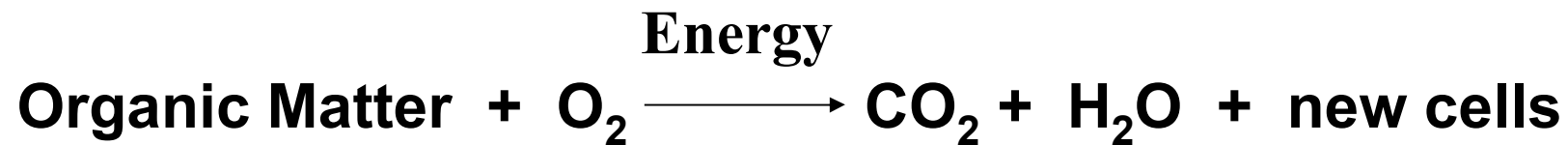
Fungi

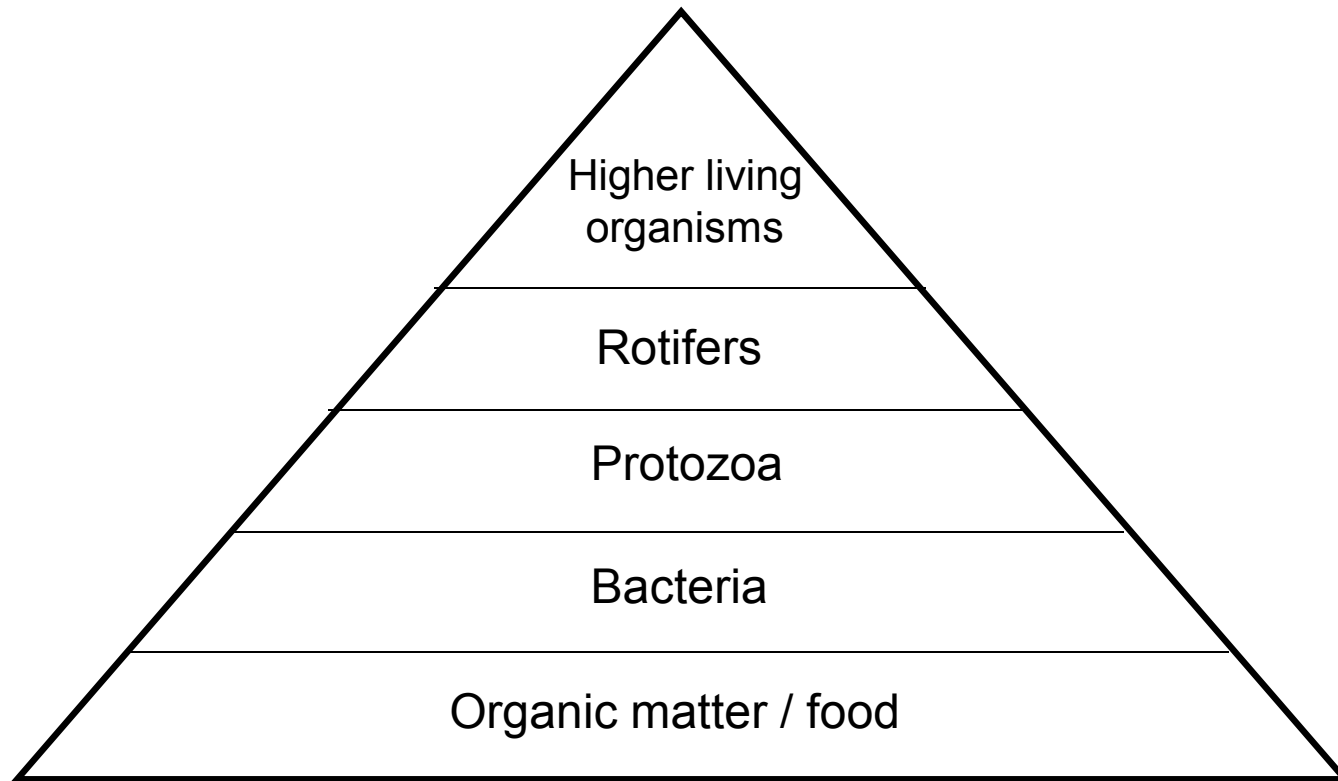
Algae

Protozoa

All the above organisms live together as one community

**The importance of these organisms in sewage treatment plants is to biodegrade organic and inorganic matter into simple compounds:**





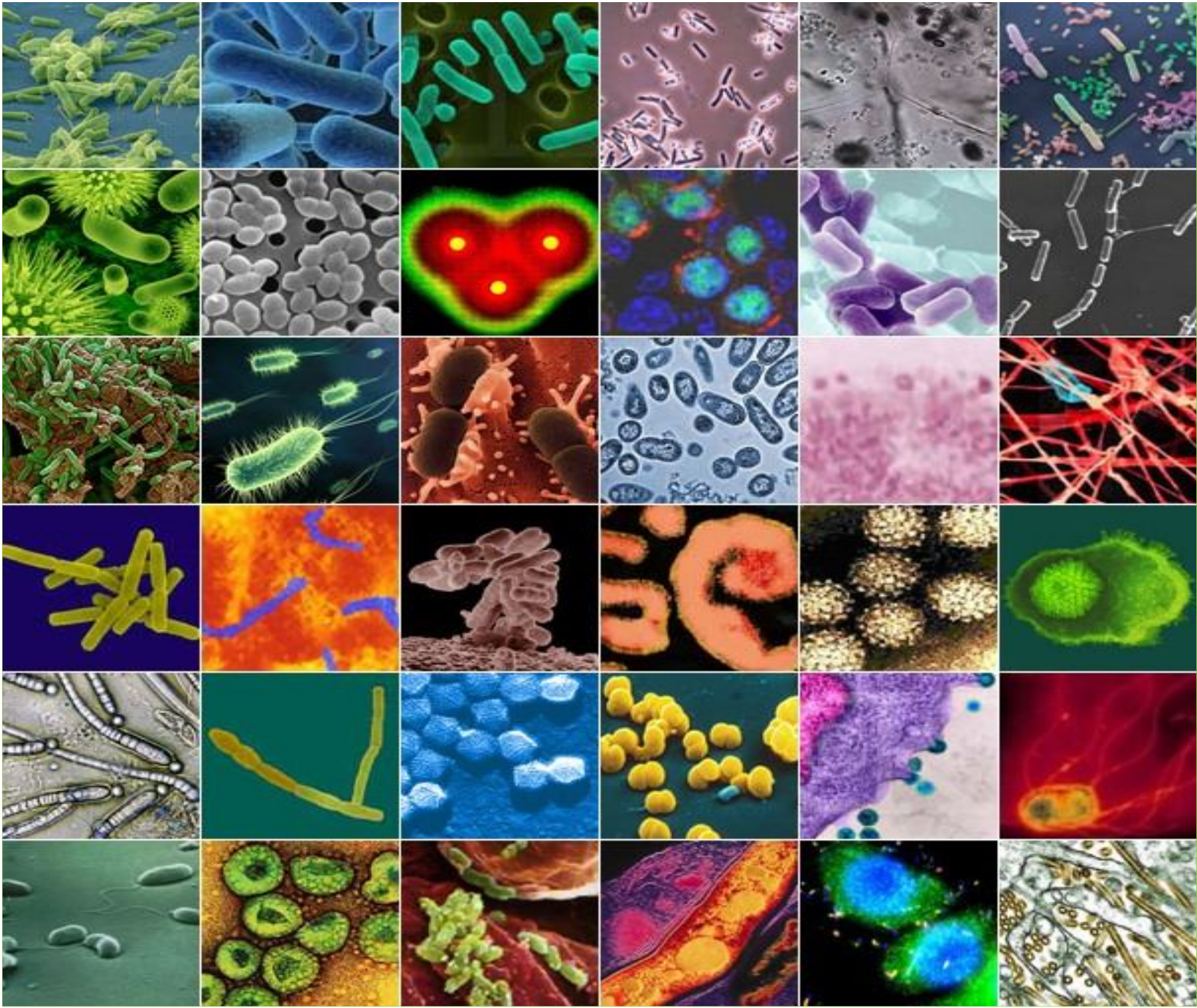
### **A typical wastewater microorganisms food pyramid**

Bacteria consumed most of the food for their growth. Different groups of microorganisms are then transfer carbon and energy from one trophic (food) level to the next trophic level

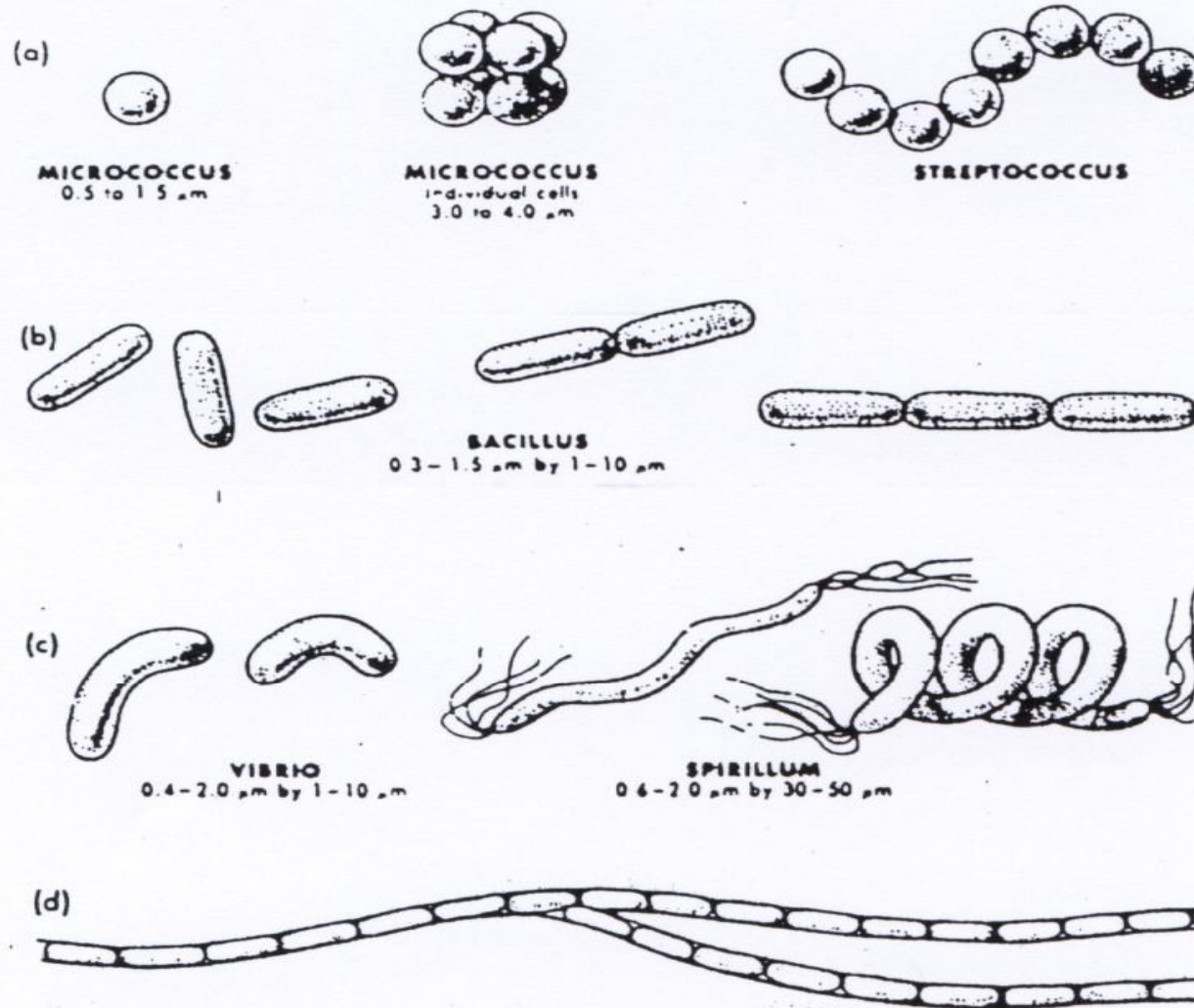
## BACTERIA

- Small organisms with size between 0.5 – 5.0  $\mu\text{m}$
- Present individually, in pairs or in chains with different kind of shape such as rod, spiral, spherical and helical
- Important in wastewater treatment.
- Single-cell microorganisms.
- The organisms reproduce through binary fission and will double themselves within 15 – 30 minute in suitable condition









Typical shapes of bacteria: (a) spheroid, (b) rod, (c) curved rod or spiral, and (d) filamentous (made up of chains of individual cells).

# CLASSIFICATION OF BACTERIA

## i. According to energy and carbon sources

- Heterotroph
  - using the **ORGANIC MATERIAL AS CARBON AND ENERGY SOURCES**
- Autotroph
  - using the **INORGANIC AS ENERGY SOURCE** and **CARBON DIOXIDE AS CARBON SOURCE**



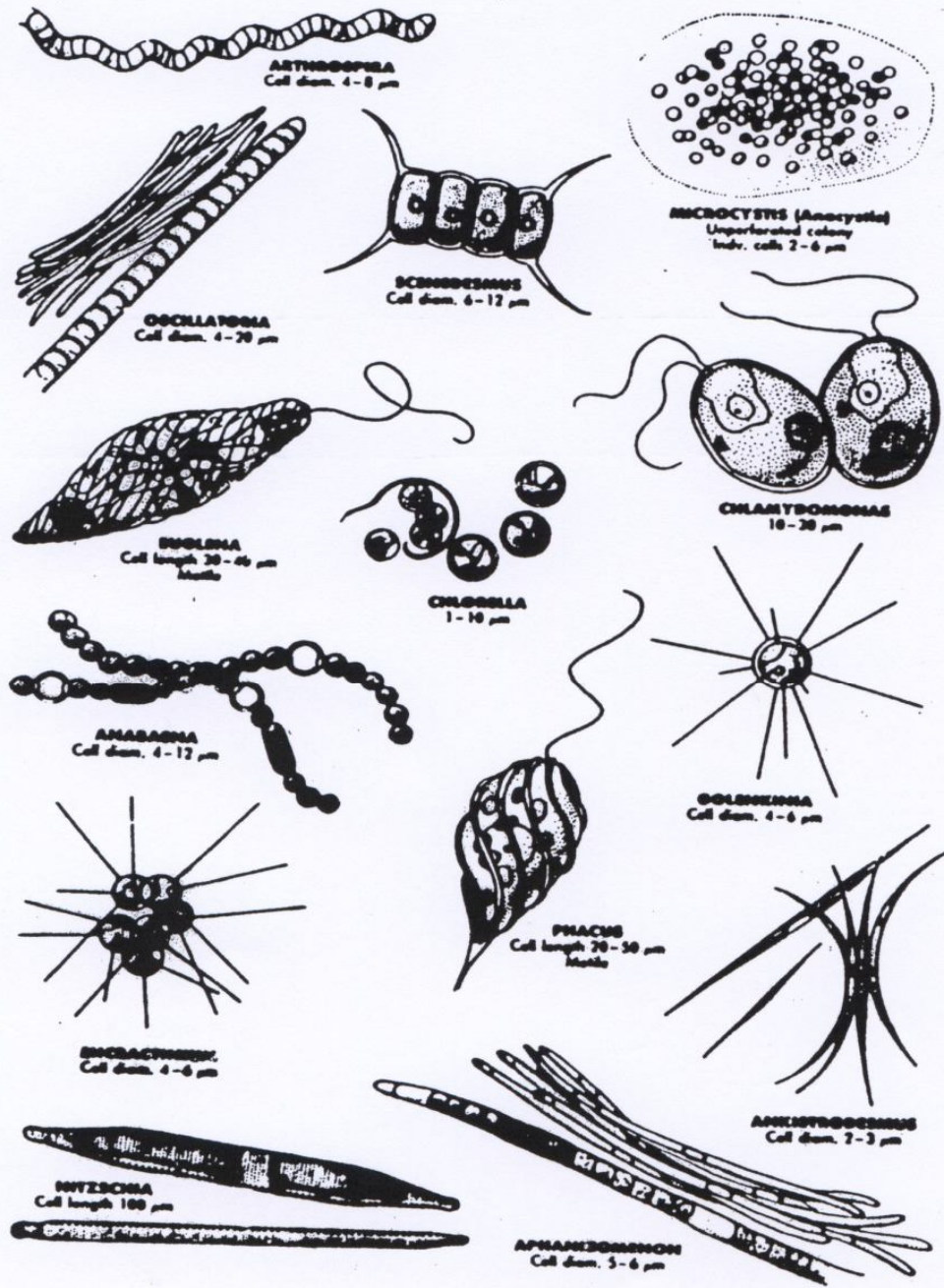
# CLASSIFICATION OF BACTERIA (CONT.)

## ii. According to the utilisation of dissolved oxygen

- Aerobe
  - USING DISSOLVED OXYGEN (DO) during the decomposition of organic compound
- Anaerobe
  - using oxygen in the form of different compound such as  $\text{NO}_3^-$ ,  $\text{SO}_4^{2-}$
- Facultative
  - able to survive in both of the above condition

# ALGAE

- Generate energy by photosynthesis.
- During the presence of sunlight, they increase the DO level in the water. This subsequently supplies oxygen to microorganisms.
- Rapid production in the presence of high concentrations of nitrogen and phosphorus.
- However, when there are too many algae in the water:
  - o Taste and smell problems
  - o Reduce the intensity of light penetration
  - o Die off – disintegrate and cause anaerobic conditions



Representative algal species found in wastewater treatment ponds













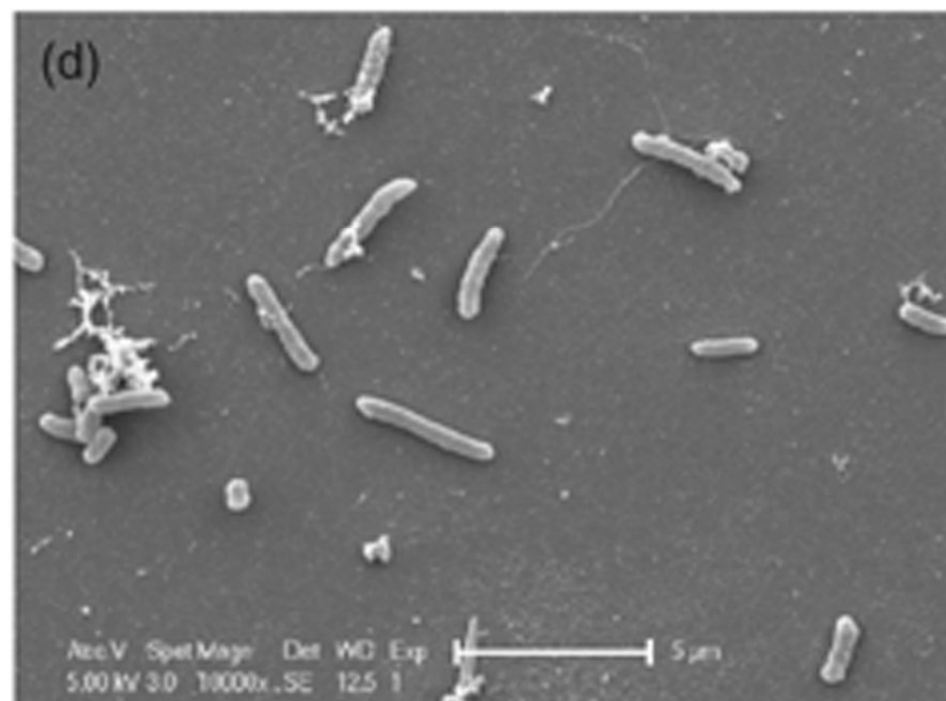
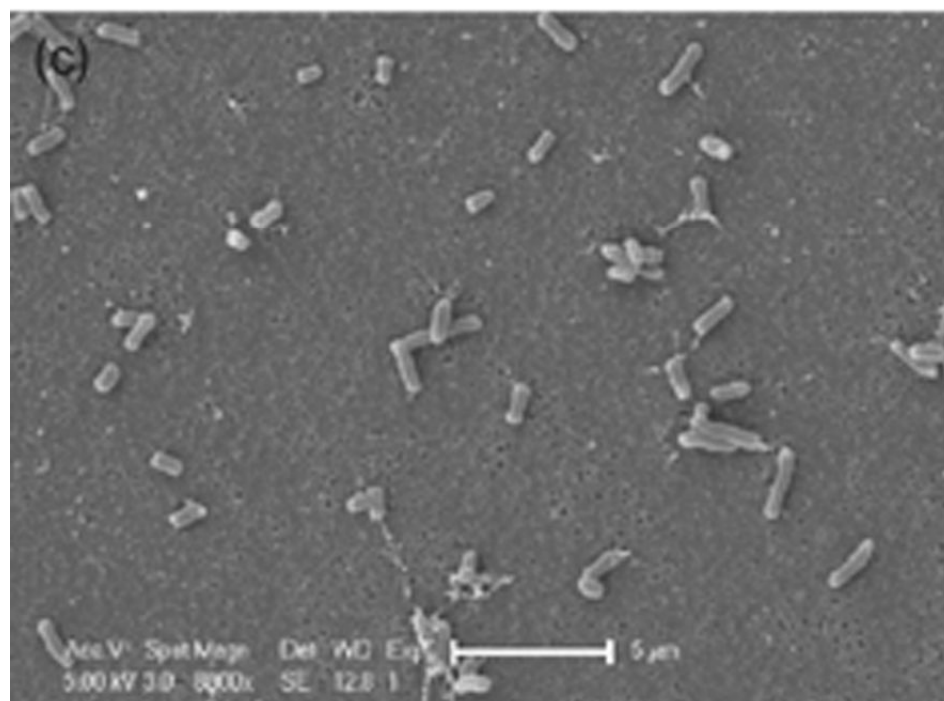
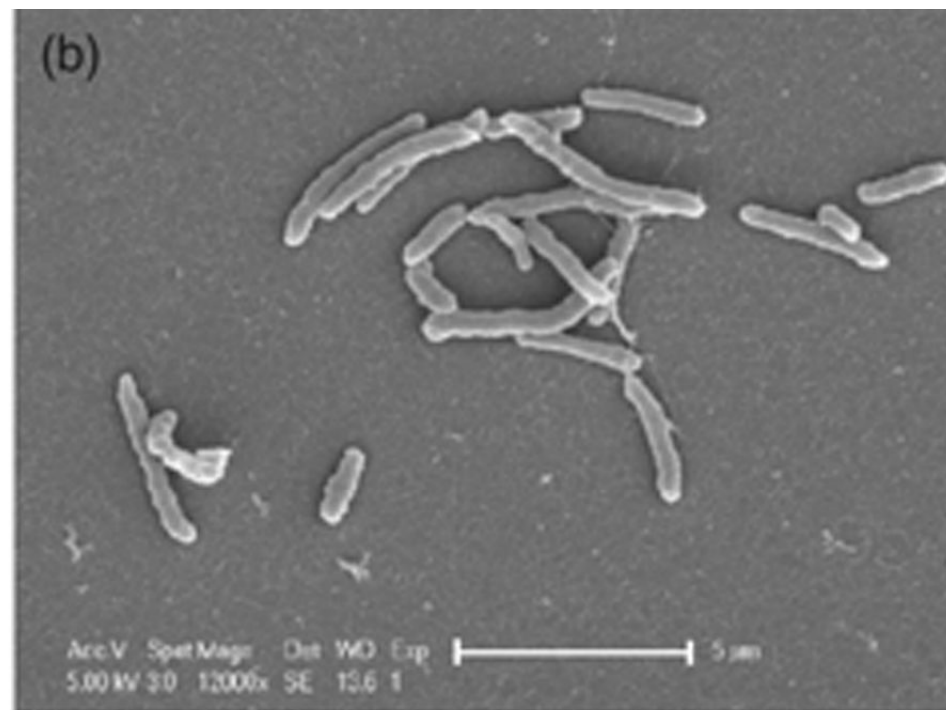
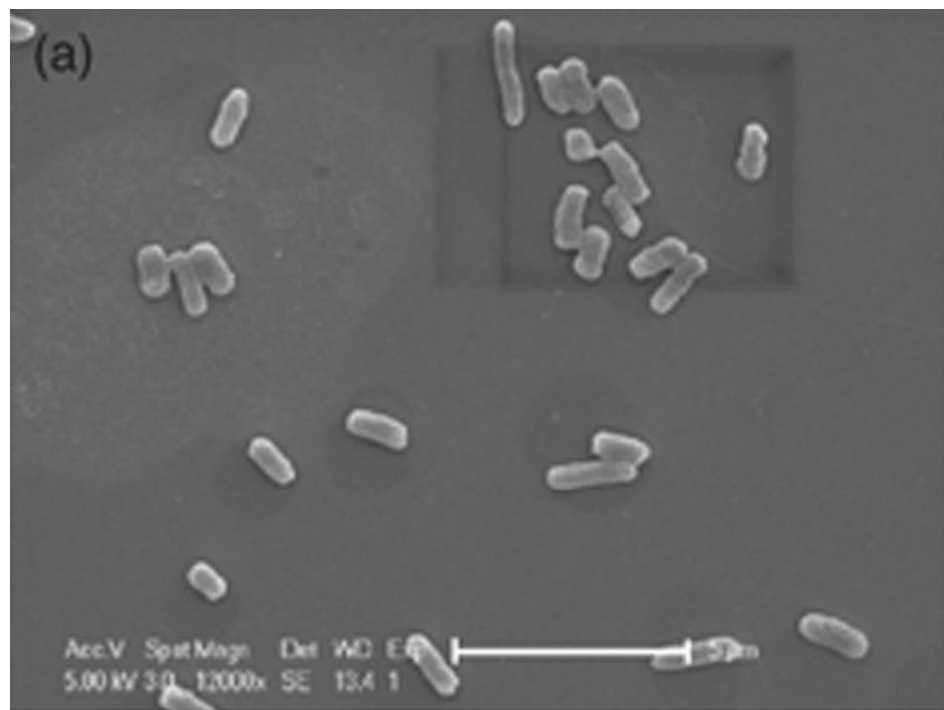
# BACTERIAL GROWTH

Asexual reproduction, or cell division, of a bacterium into two daughter cells, in a process called binary fission.

*Did you know that ...*

1 bacteria divided into 2 every 20 min could produce more than 5,000 billion billion bacteria in 1 day !!

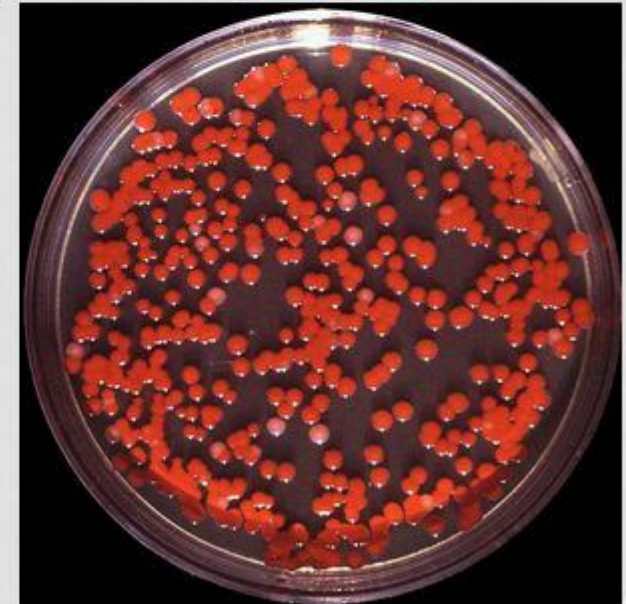


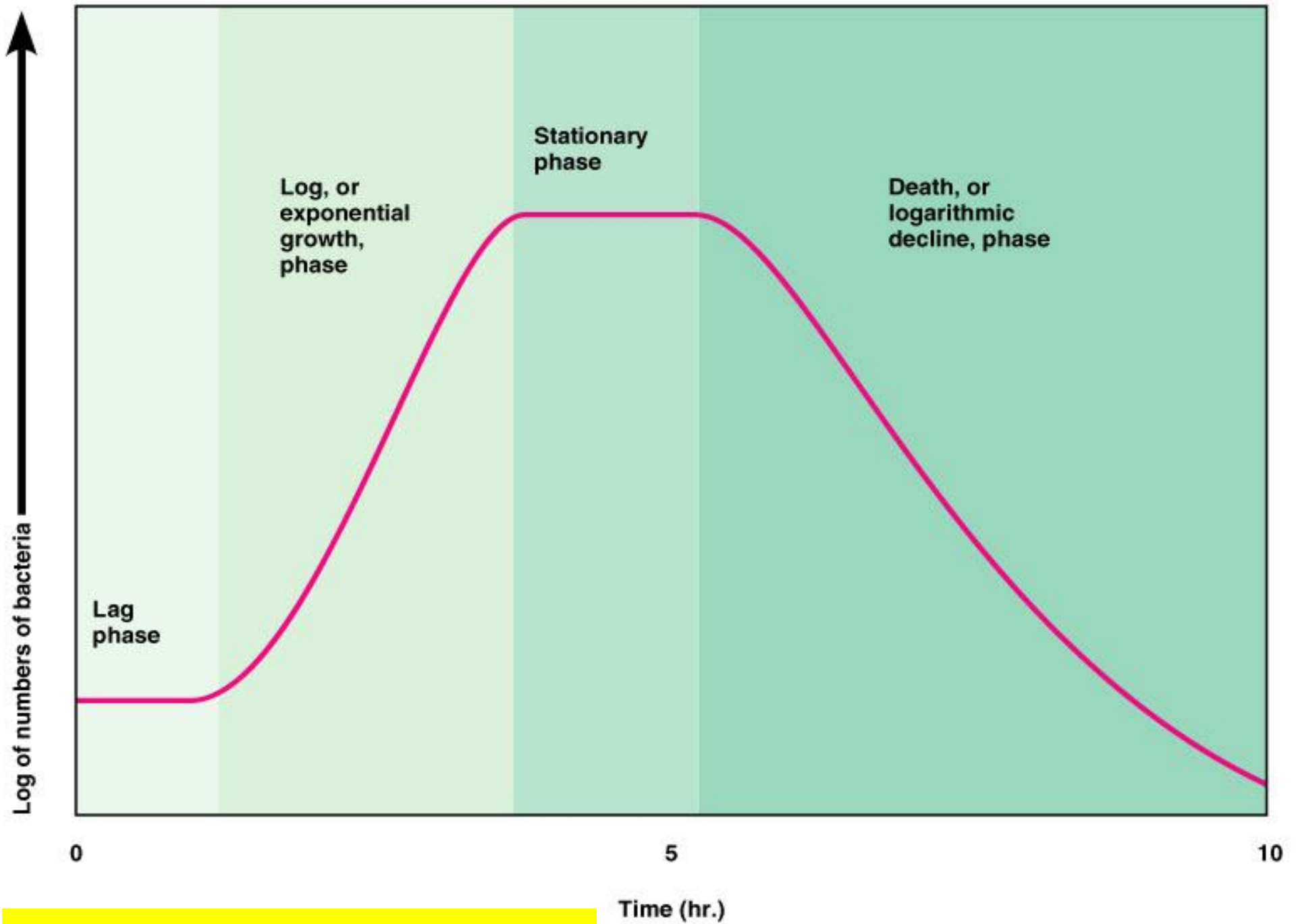




# What Do We Mean By Bacterial Growth?

- When we are talking about bacterial growth we are really referring to the number of cells, not the size of the cells.
- Bacteria that are growing are increasing in number, accumulating into colonies of hundred of thousands of cells, or population of billion of cells.
- A colony should have millions of bacterial cells to be seen by naked eye.





## BACTERIAL GROWTH CURVE

### Lag Phase:

The time required for the organisms to acclimatize (adapt) to their new environment and begins to divide.

### Exponential Growth (Log) Phase:

The presence of excess substrate (**food**) promotes the maximum rate of growth possible, limited only by the ability of the bacteria to reproduce.

### Stationary Phase:

Here the population remains stationary. Reasons for this phenomenon are

- (i) that the cells have exhausted the substrate or nutrients necessary for growth and
- (ii) that the growth of new cells is offset by the death of old cells

### Death/Endogenous Phase (Decline):

During this phase, the bacteria death rate exceeds the production of new cells. Depletion of nutrient/food and oxygen, and toxic by-products of cell metabolism inhibit further growth.

