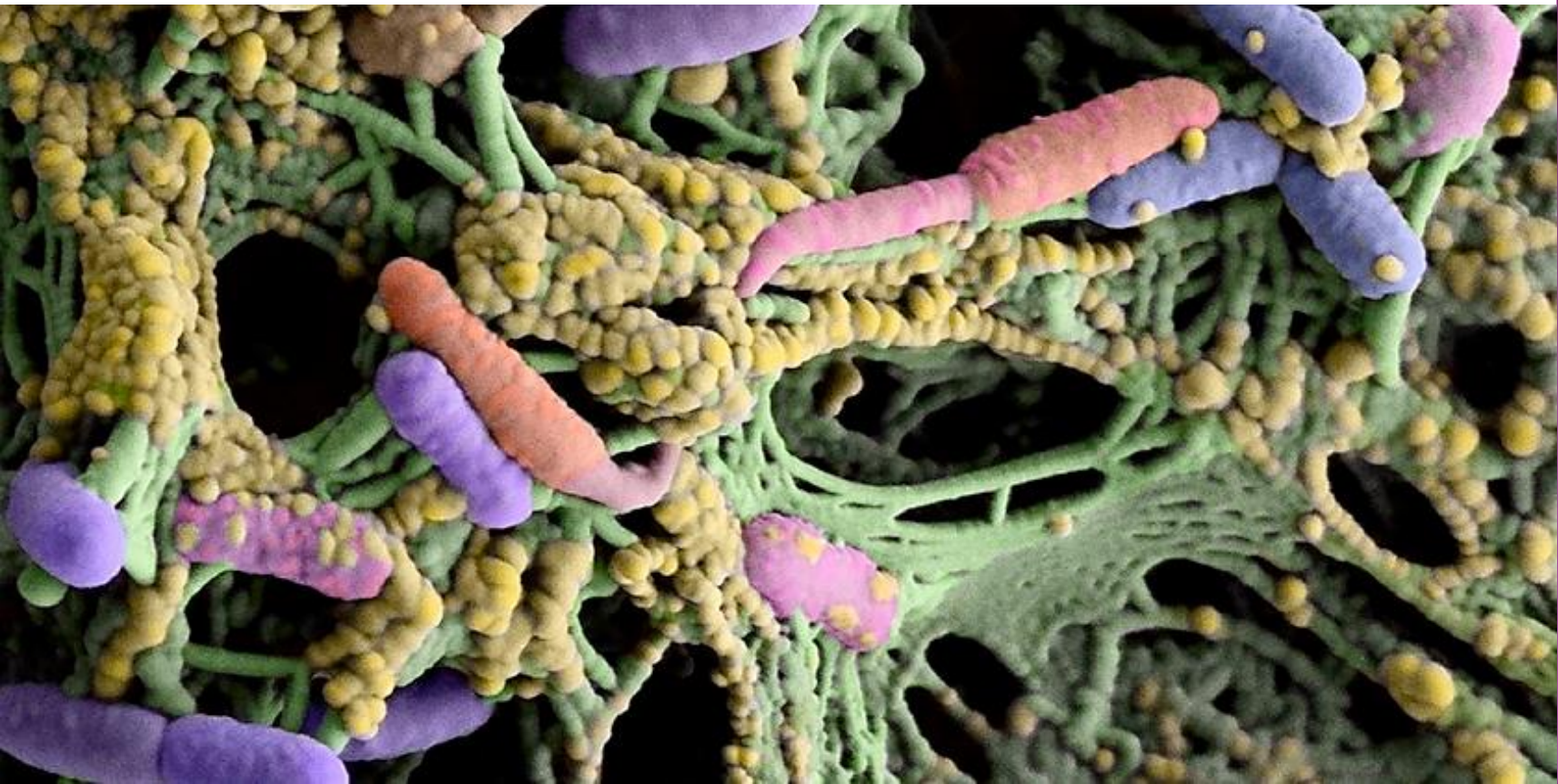


CHAPTER 2.0

ENVIRONMENTAL MICROBIOLOGY



MICROORGANISMS THAT PLAY AN IMPORTANT ROLE IN ENVIRONMENTAL ENGINEERING ARE:

Bacteria

Viruses

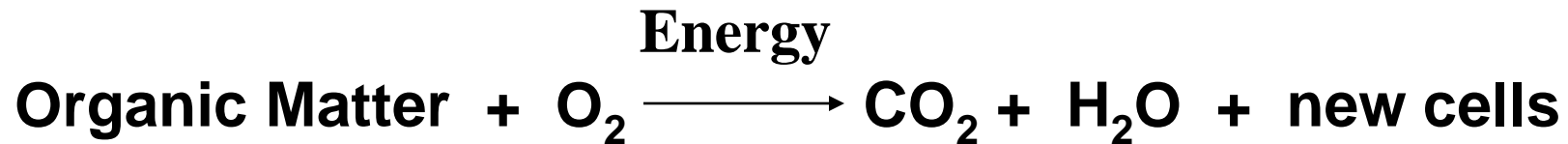
Fungi

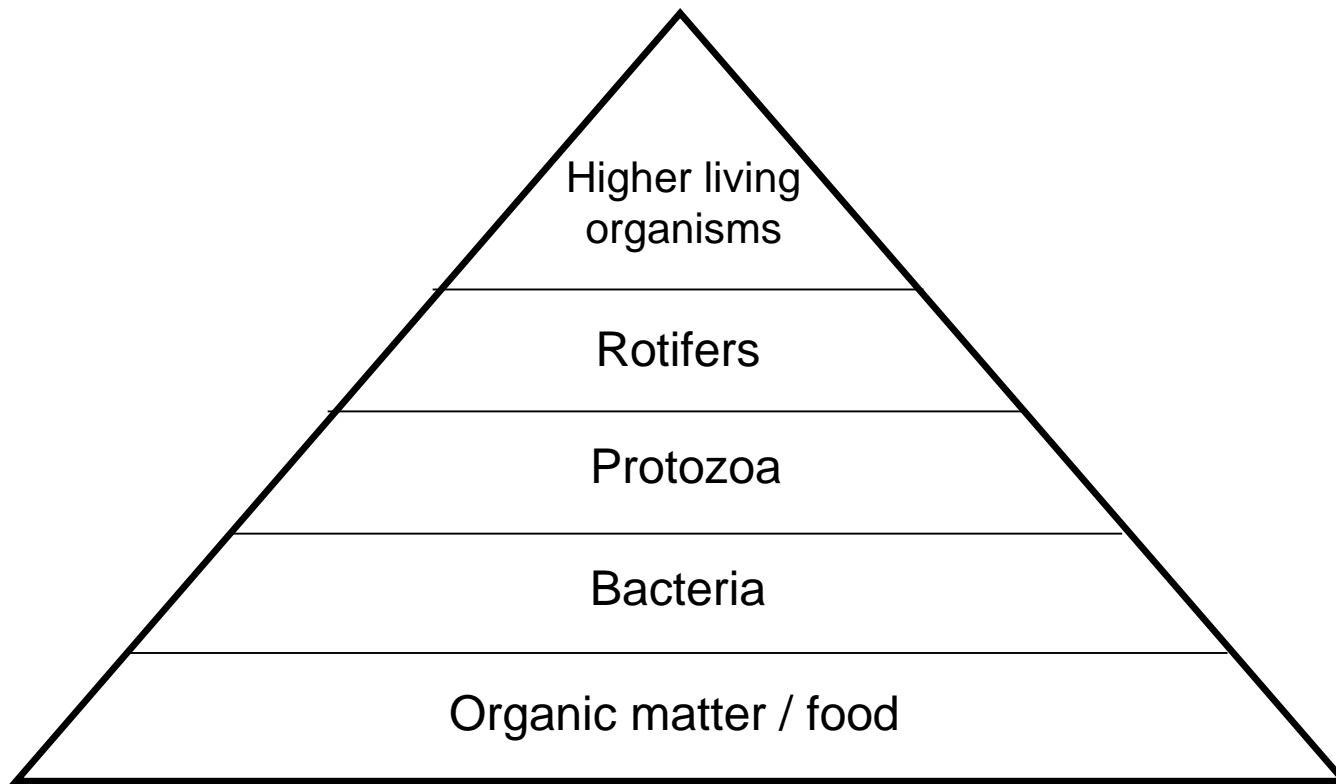
Algae

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:



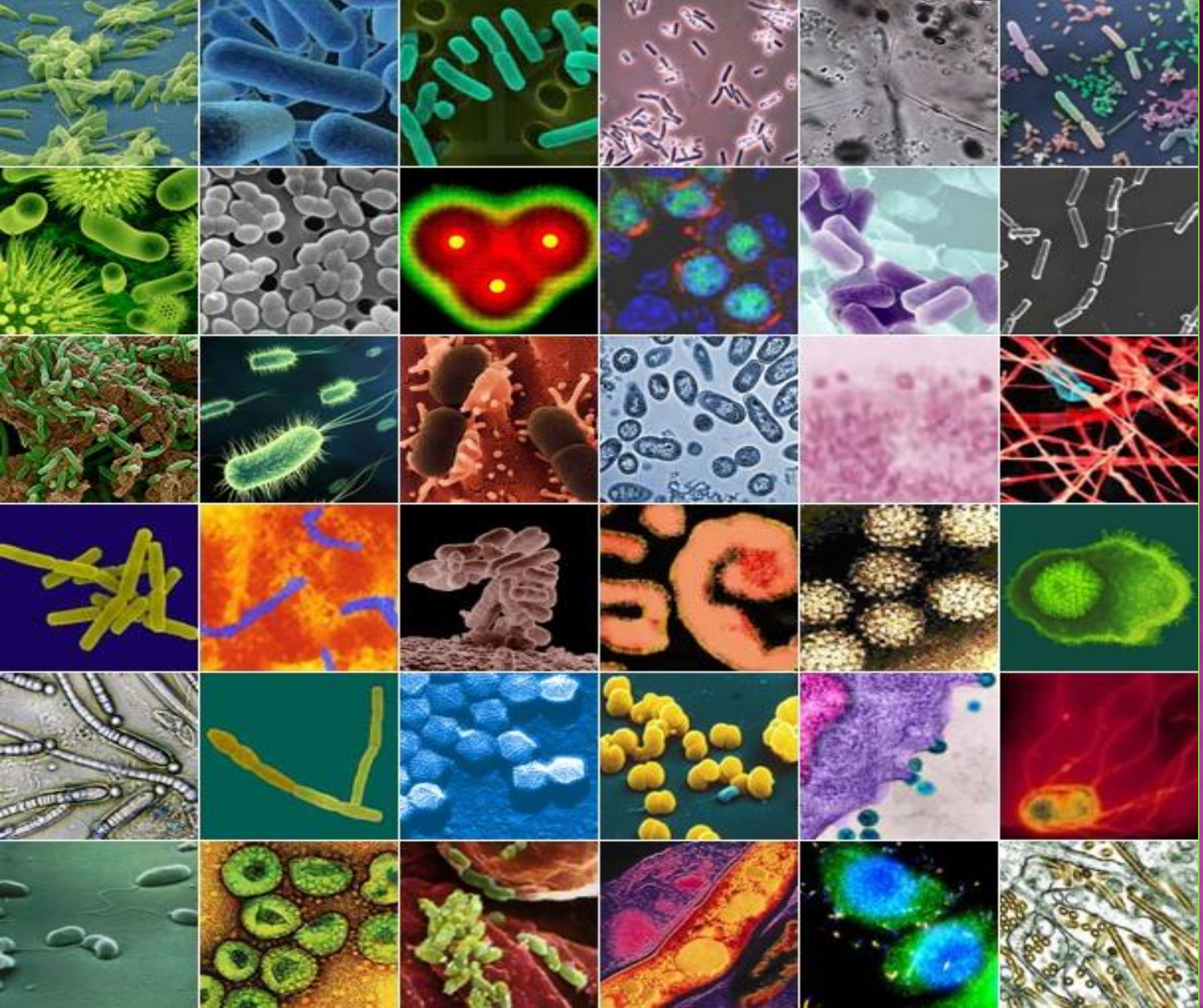


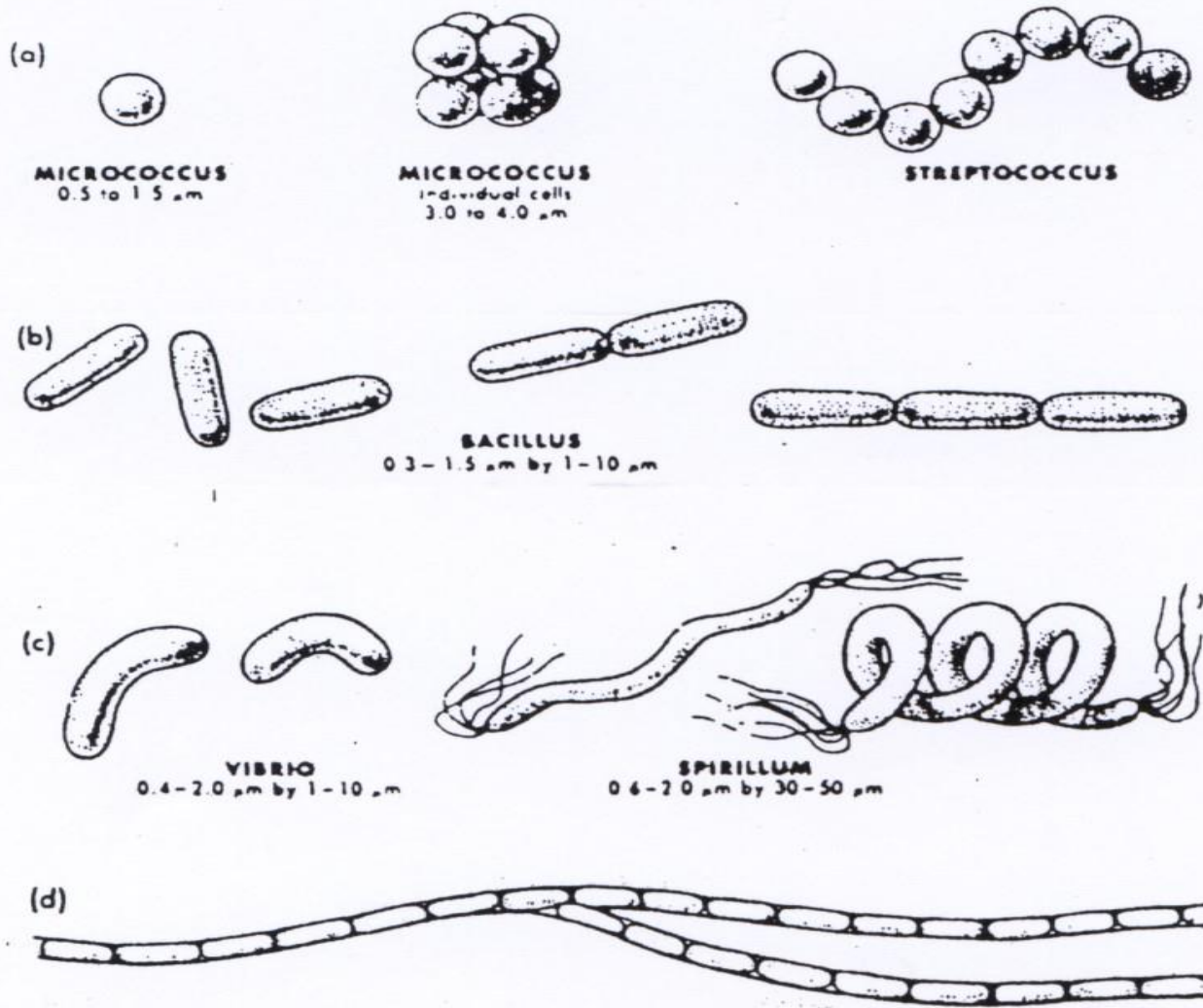
A typical wastewater microorganisms food pyramid

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 μm
- 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** COMPOUNDS AS CARBON AND ENERGY SOURCES
- Autotroph
 - using the **INORGANIC** COMPOUNDS AS CARBON AND ENERGY SOURCES

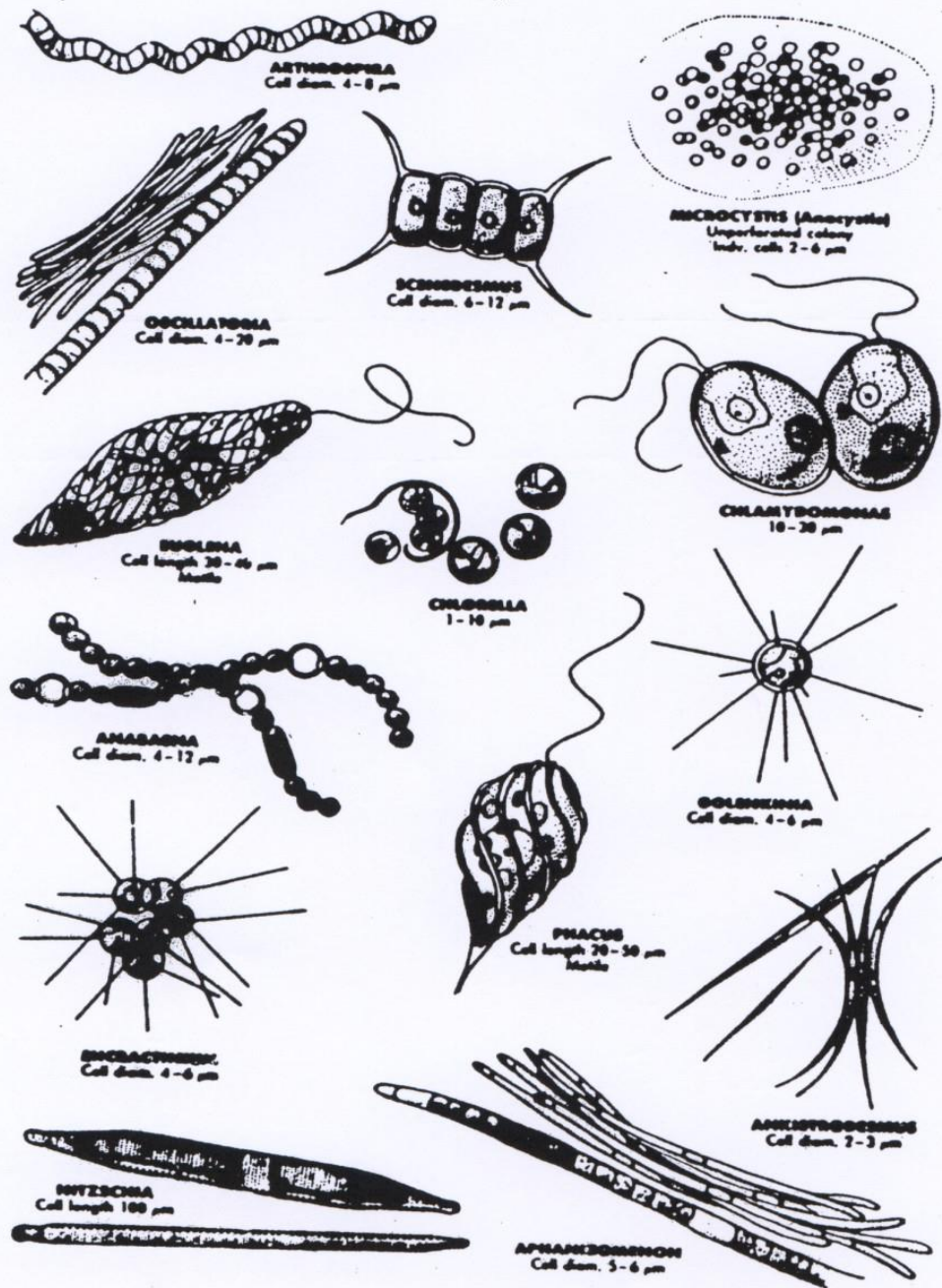
CLASSIFICATION OF BACTERIA (CONT.)

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 NO_3^- , SO_4^{2-}
- Facultative
 - able to survive in both of the above condition

ALGAE

- **Autotrophic organisms.**
- Generate energy by photosynthesis.
- During the presence of sunlight, they metabolize the waste product of bacteria (CO_2 , NO_3 , PO_4 , etc.), which increase DO level in the water. This subsequently supply oxygen to microorganisms.
- Rapid production in the presence of high concentrations of nitrogen and phosphorus.
- However, when there are too much of algae in the water:
 - o Taste and smell problems
 - o Reduce the intensity of light penetration
 - o Die off – disintegrate and cause anaerobic condition



Representative algal species found in wastewater treatment ponds







BACTERIAL GROWTH

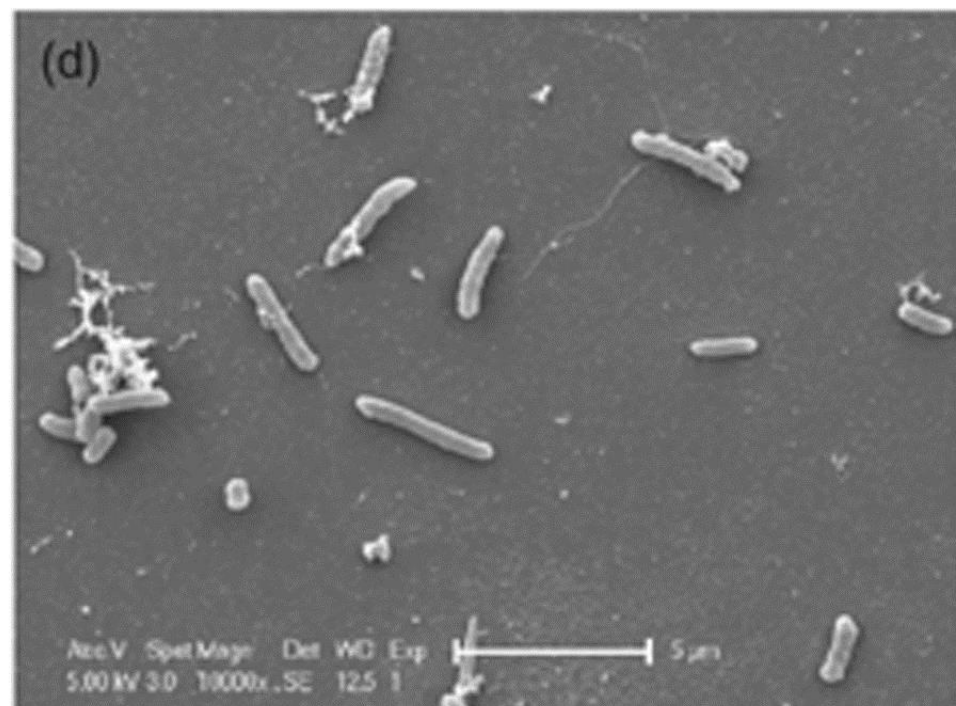
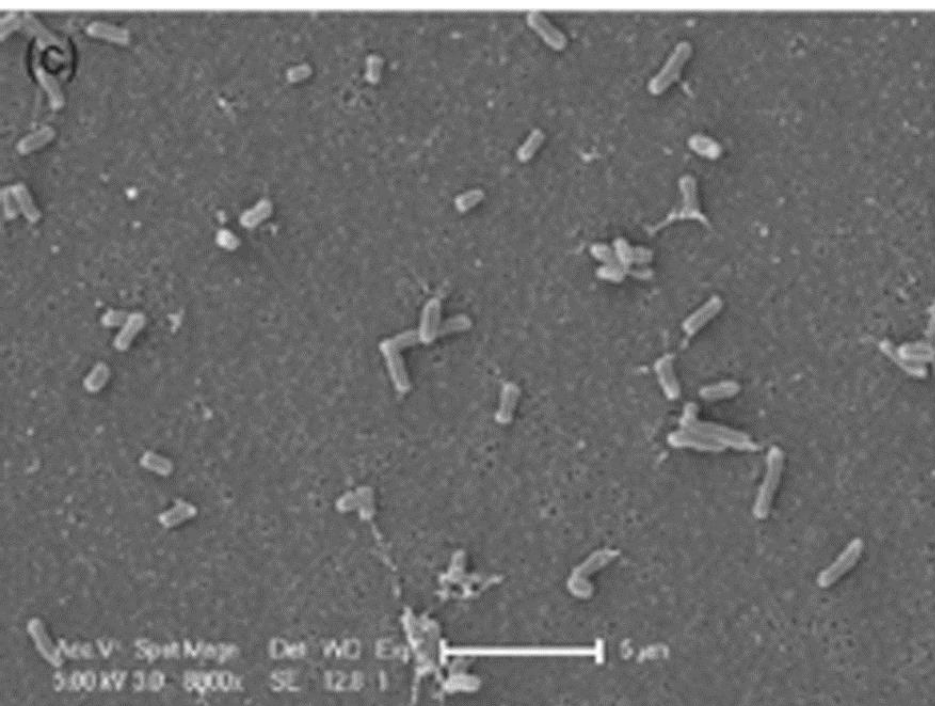
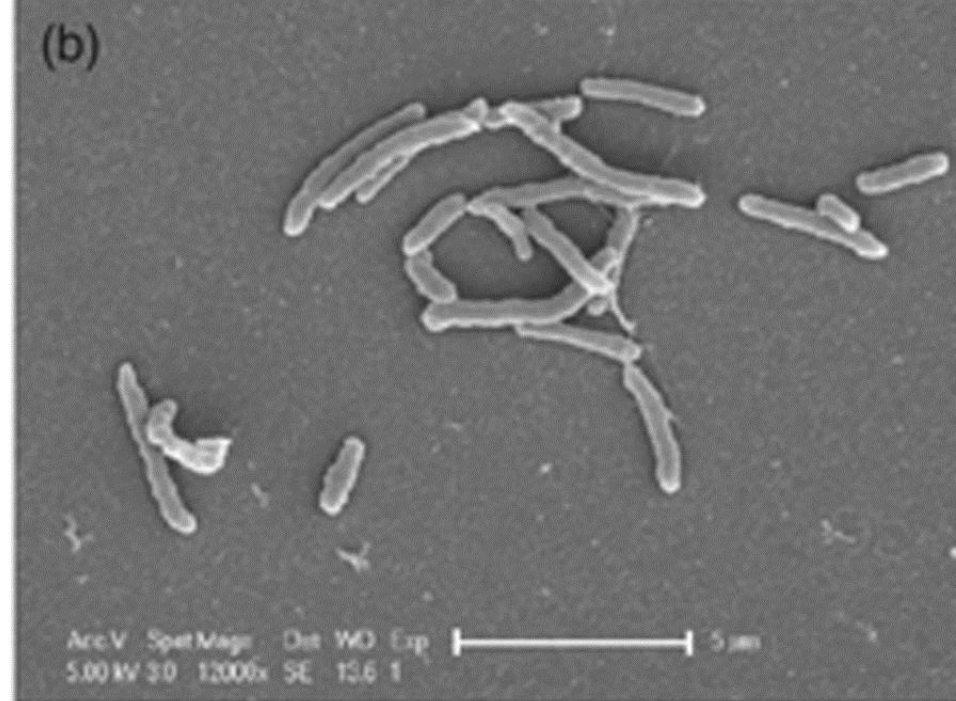
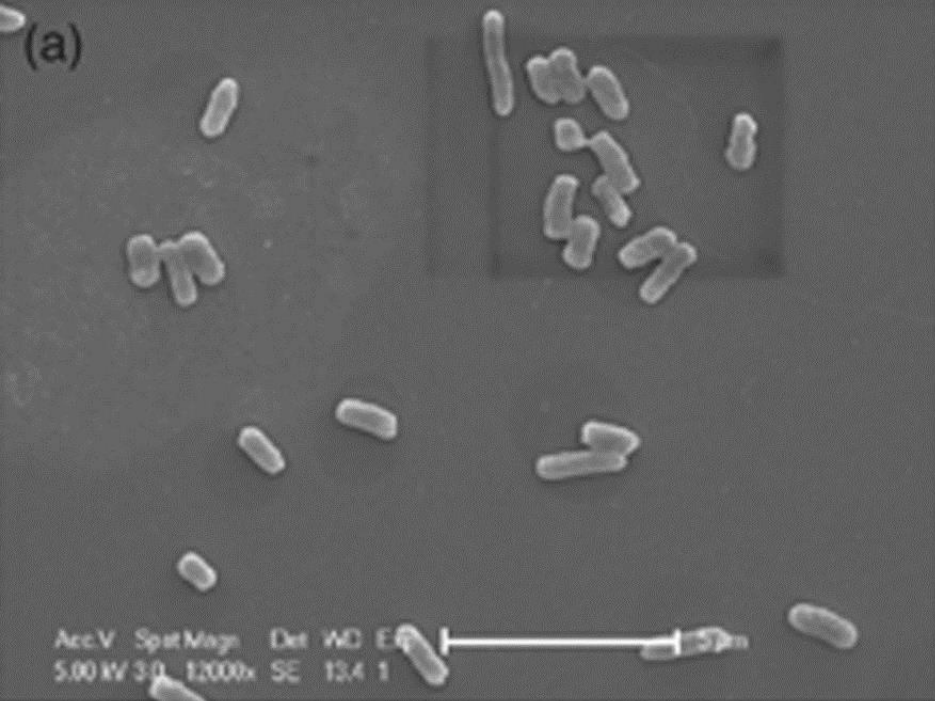
Asexual reproduction, or cell division, of a bacterium into two daughter cells, in a process called binary fission.

Did you know that ...

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

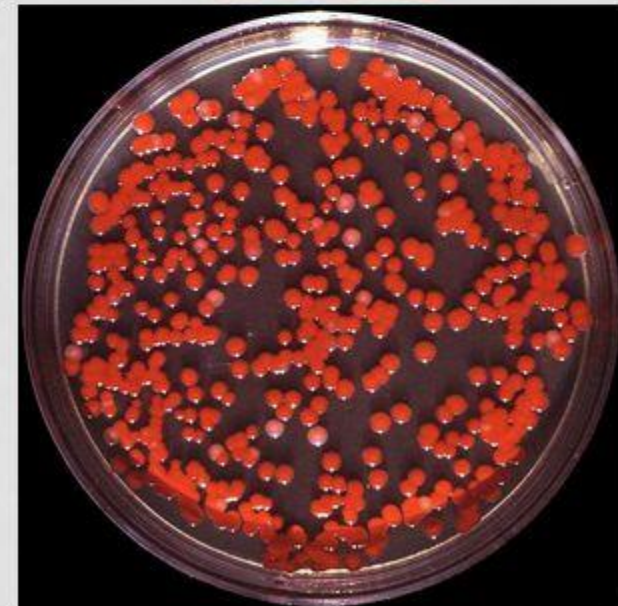


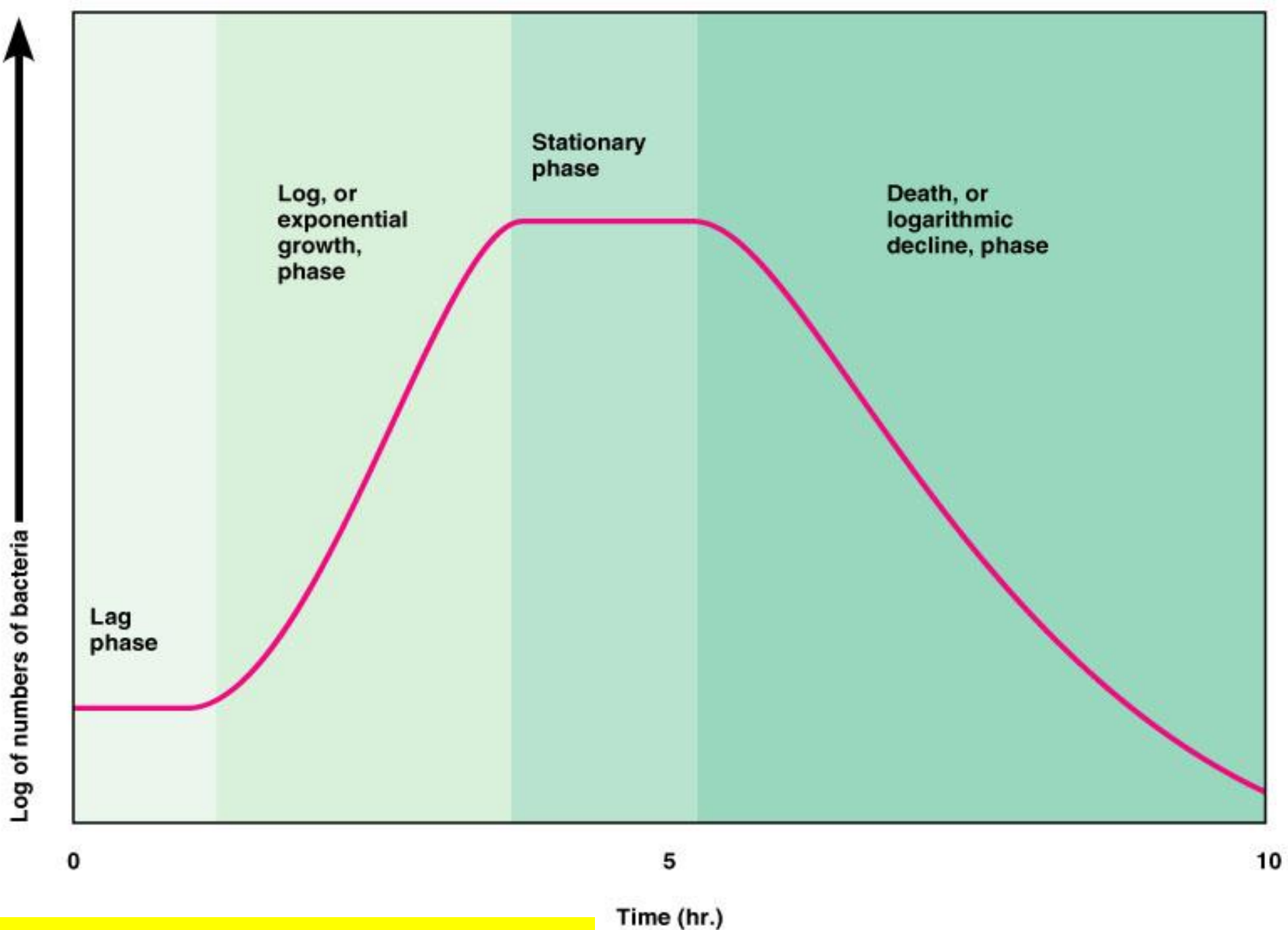




What Do We Mean By Bacterial Growth?

- 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.

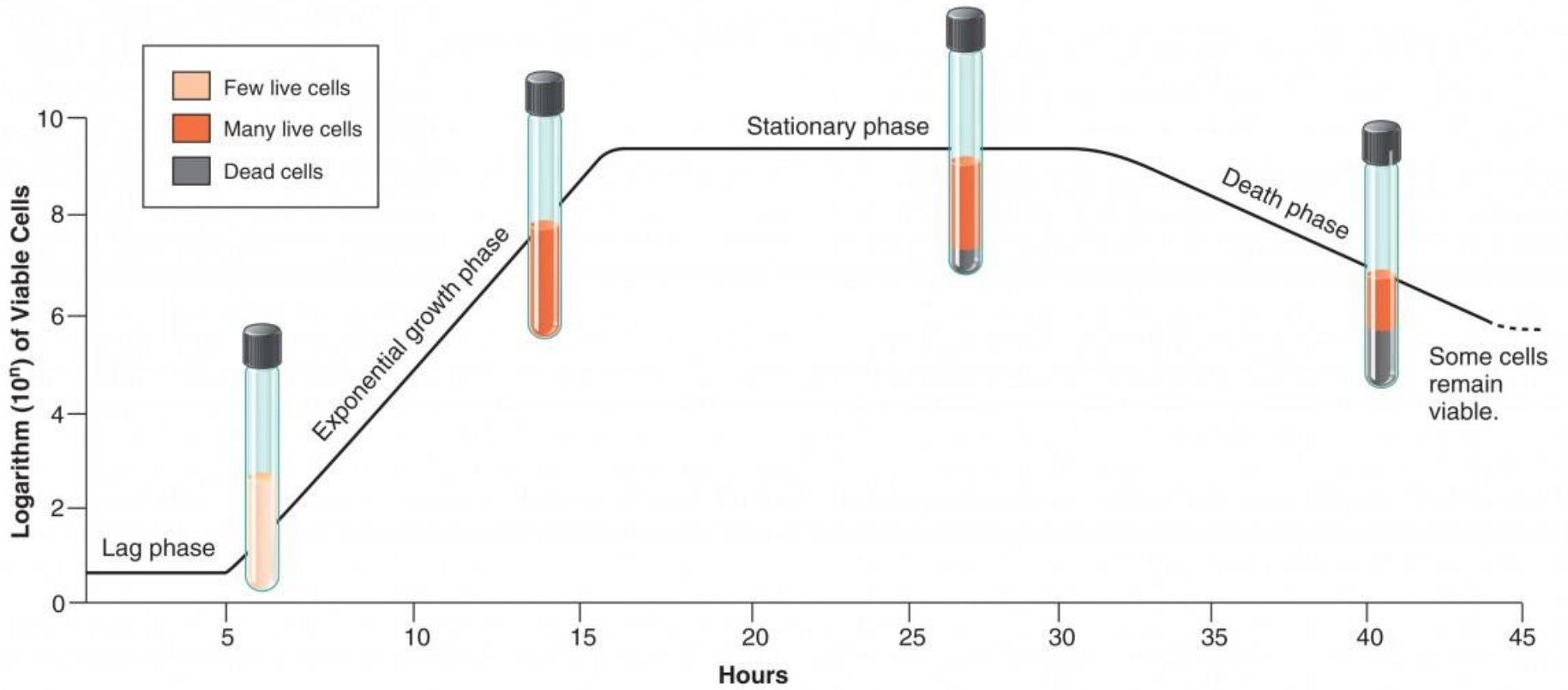
Stationary Phase:

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.



Total cells in population, live and dead, at each phase.