

# **Wastewater Engineering**

**SKAB2922**

**Dr. Mohamad Darwish**

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**LECTURE PLANNING**

<b>WEEK</b>	<b>LECTURE</b>	<b>TOPIC / CONTENT</b>	<b>DATE</b>
1	1 2	Introduction Environmental Microbiology – Types and Classes	
2	3 4	Environmental Microbiology – Metabolism and Biological Growth in Wastewater Treatment Wastewater – Types, Characteristics – SS	
3	5 6	Wastewater - Characteristics – BOD Wastewater - Characteristics – COD	
4	7 8	Discharge Standards & Sewerage Act Wastewater Quantity	
5	9 10	Sewer System <b>Test 1</b>	9 October 2018
6	11 12	Introduction to Sewage Treatment System Preliminary Treatment	
7	13 14	Primary Treatment – Primary Clarifier Design Introduction to Secondary Treatment	
8	15 16	Activated Sludge – Principles and Concept Conventional Activated Sludge – Design	
9		<b>MID SEMESTER BREAK</b>	6 - 8 November 2018
10	17 18	Conventional Activated Sludge – Design Extended Aeration – Design	
11	19 20	Sequencing Batch Reactor Trickling Filters - Principles and Concept	
12	21 22	Trickling Filters – Biological Tower Design Waste Stabilization Pond – Principles and Concept	
13	23 24	Waste Stabilization Pond – Design Site Visit to Sewage Treatment Plant	
14	25 26	Aerated Lagoon – Principles, Concept and Design <b>Test 2</b>	11 December 2018
15	27 28	Sludge – Sources and Quantity Sludge Treatment and Disposal	
16-18		<b>REVISION WEEK AND FINAL EXAMINATION</b>	

### **DISTRIBUTION OF MARKS**

1.	Assignment	10 %
2.	Test 1 (1 hour)	20 %
3.	Test 2 (1 hour)	20 %
4.	Final Examination (2 hours)	40 %
5.	Generic Skill (Life Long Learning)	10 %
	<b>TOTAL</b>	<b>100 %</b>

## Contact ...

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# What do you expect from this course ?

- Basic concepts of microbiology, wastewater characteristics, sewer system, wastewater and sludge treatment system.
- Solve some of wastewater parameters.
- Design each unit of process in sewage treatment plant.
- Current environmental problems.

# **CHAPTER 1.0**

## **INTRODUCTION**

# What is wastewater?

“Wastewater”, also known as “sewage” originates from residential, commercial, and industrial area.



# Why treat wastewater?





- Untreated wastewater harmful to health
- Breeding sites for insects, pests and micro organisms
- Can cause environmental pollution and affect ecosystem

Water Loop  
Nutrient Loop

Water Sources

Purification

Water Distribution

Agricultural Use

Domestic Use

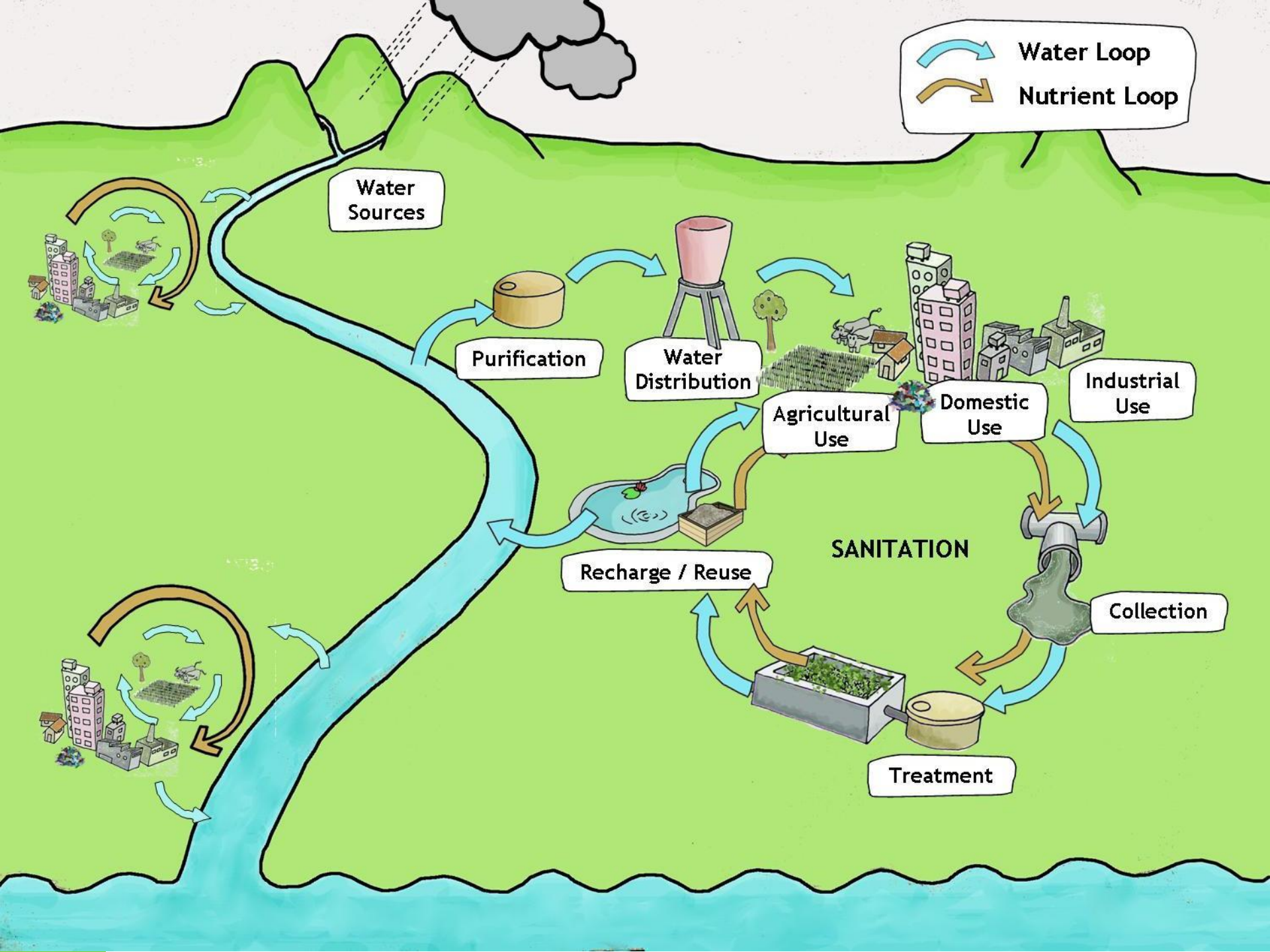
Industrial Use

SANITATION

Recharge / Reuse

Collection

Treatment



# The Role of the Engineer

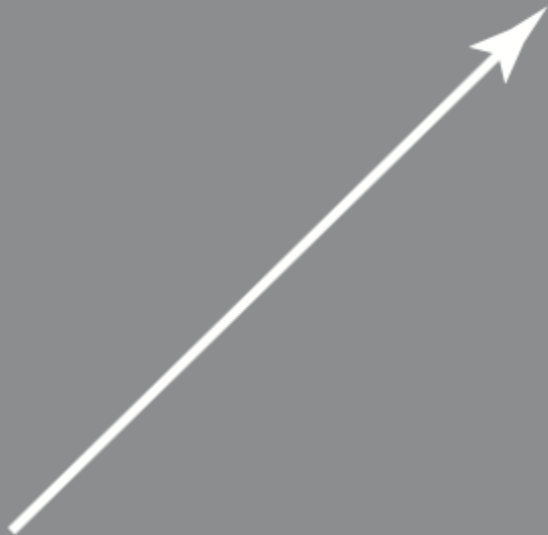


- Wastewater engineers are involved in the conception, planning, evaluation, design, construction, and operation and maintenance of the systems.
- An understanding of the nature of wastewaters is essential in the design and operation of collection, treatment, and disposal facilities.
- The elements of wastewater systems and the associated engineering task are listed in Table 1.0

**Table 1.0 Elements of wastewater management systems and associated engineering task**

<b>Element</b>	<b>Engineering Task</b>
<b>Wastewater Generation</b>	<b>Estimation of the quantities of wastewater, determination of wastewater characteristics</b>
<b>Collection system</b>	<b>Design of sewers</b>
<b>Treatment (wastewater and sludge)</b>	<b>Selection, analysis, and design of treatment operation and processes to meet specified treatment objectives</b>
<b>Disposal and reuse (wastewater and sludge)</b>	<b>Design of facilities used for the disposal and reuse of treated effluent in the aquatic and land environment, and the disposal and reuse of sludge</b>

**SUCCESS**



What people  
think it  
looks like

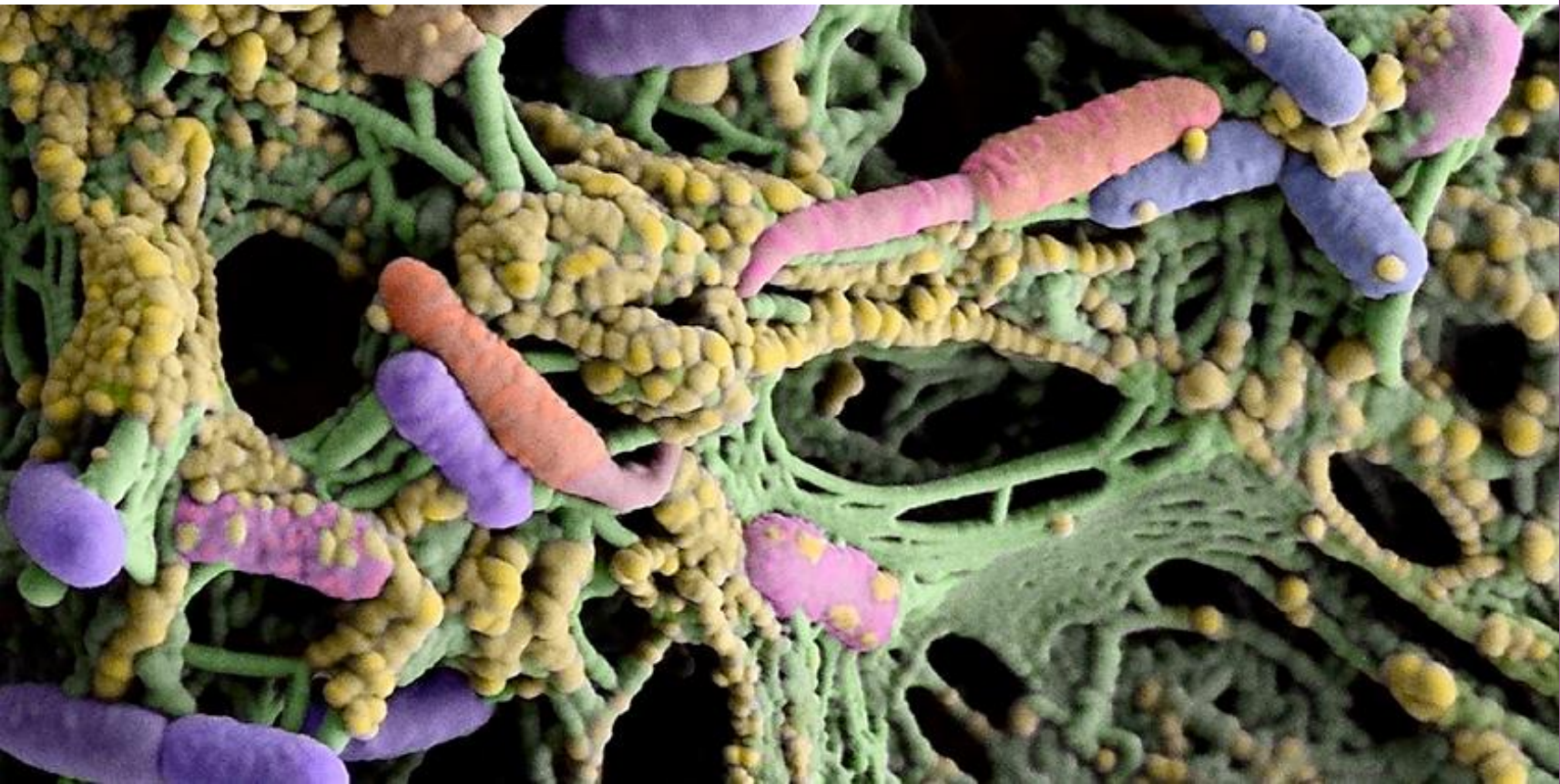
**SUCCESS**



What it  
really  
looks like

# CHAPTER 2.0

## ENVIRONMENTAL MICROBIOLOGY



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

Bacteria

Viruses

Fungi

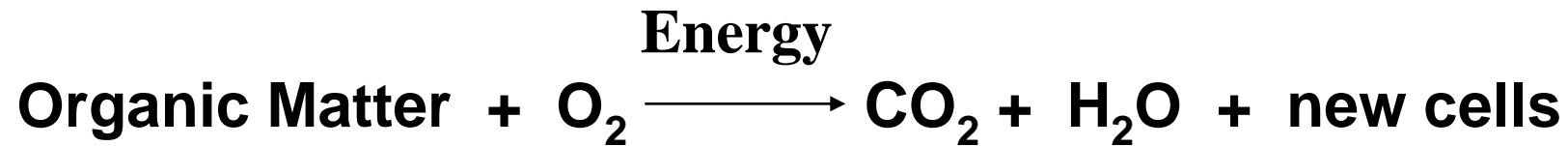
Algae

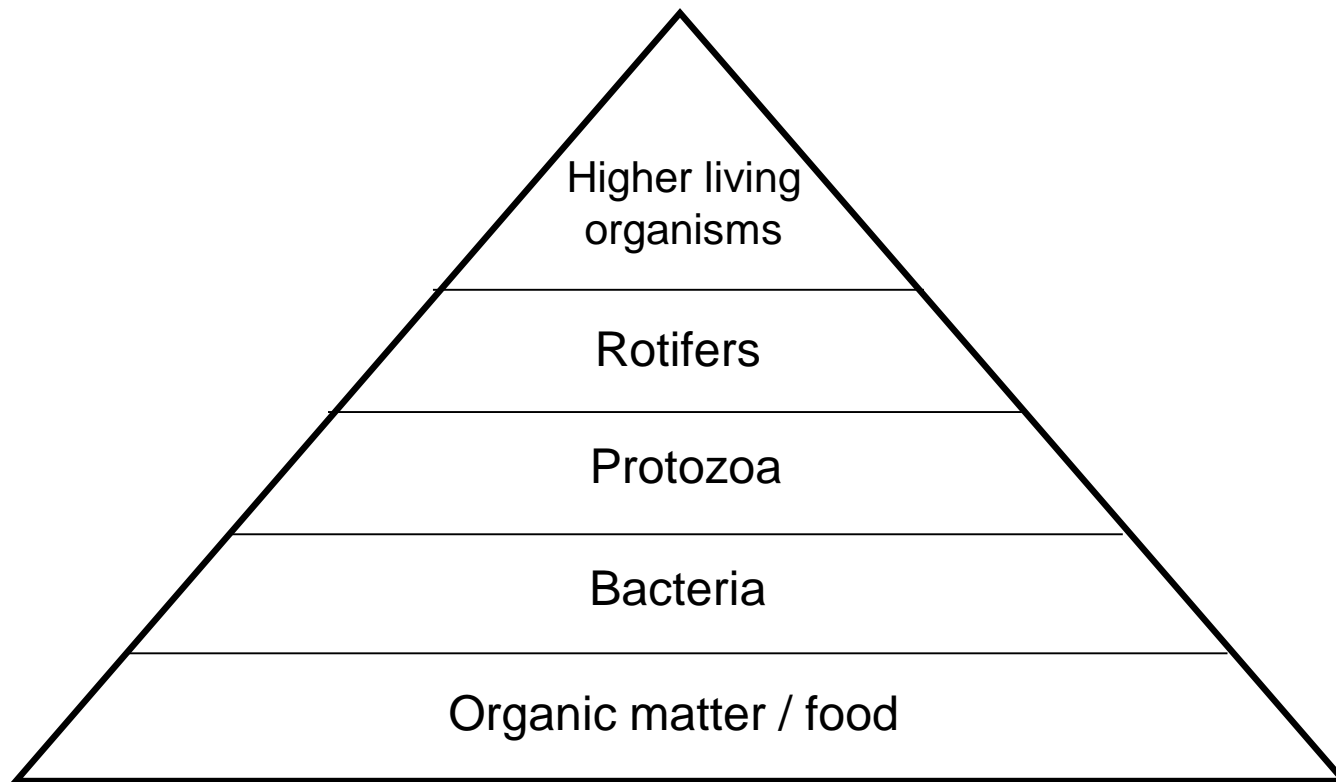
Protozoa

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:**

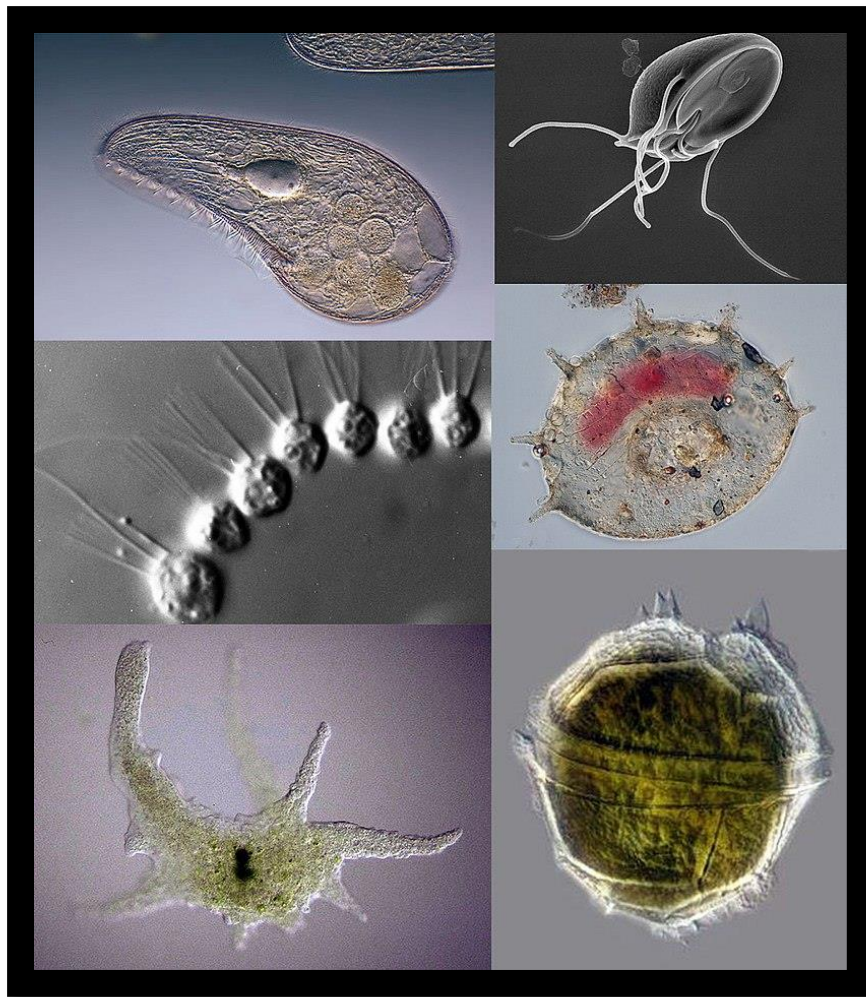




### **A typical wastewater microorganisms food pyramid**

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

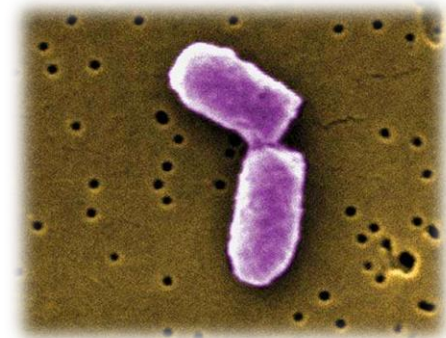


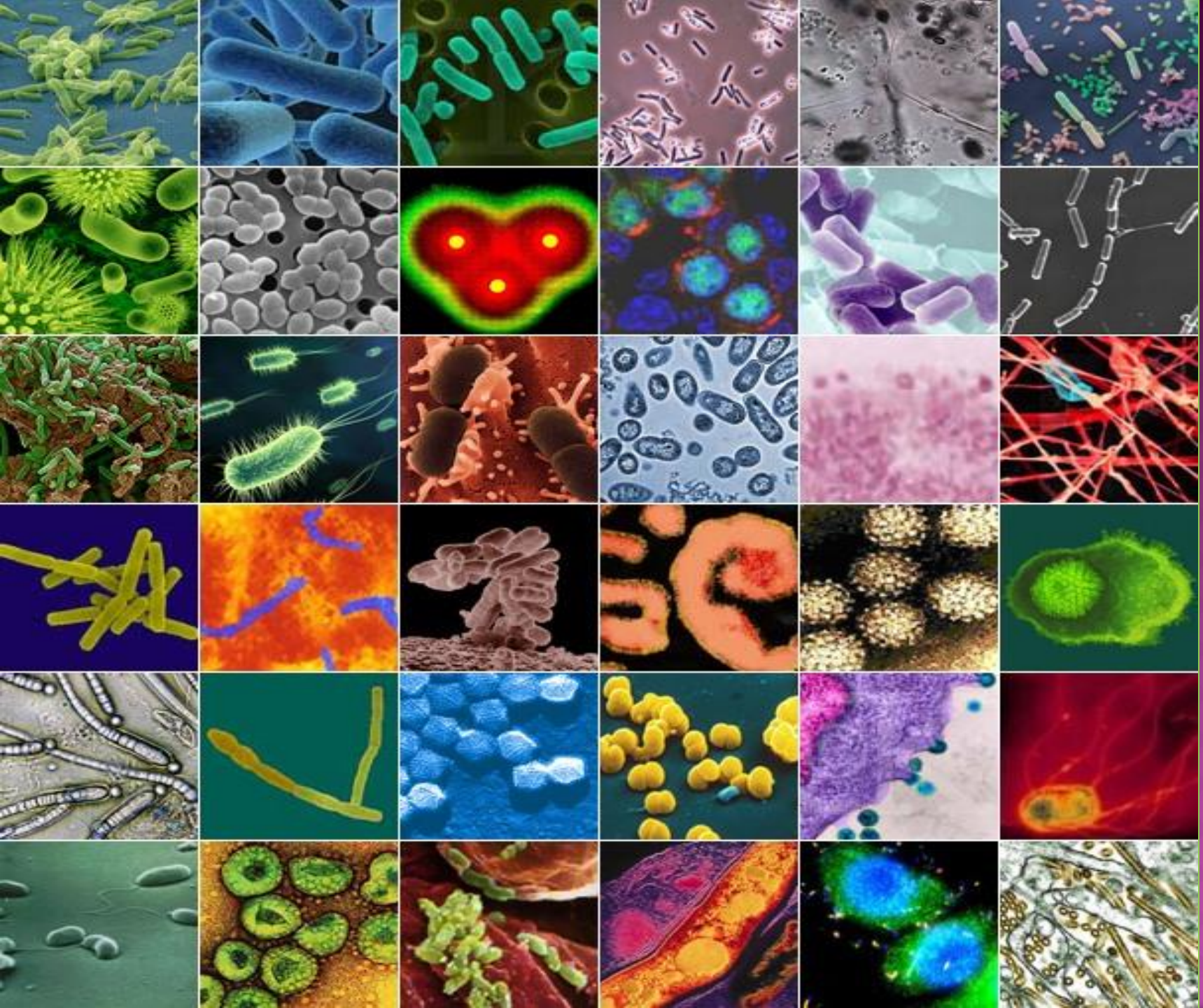


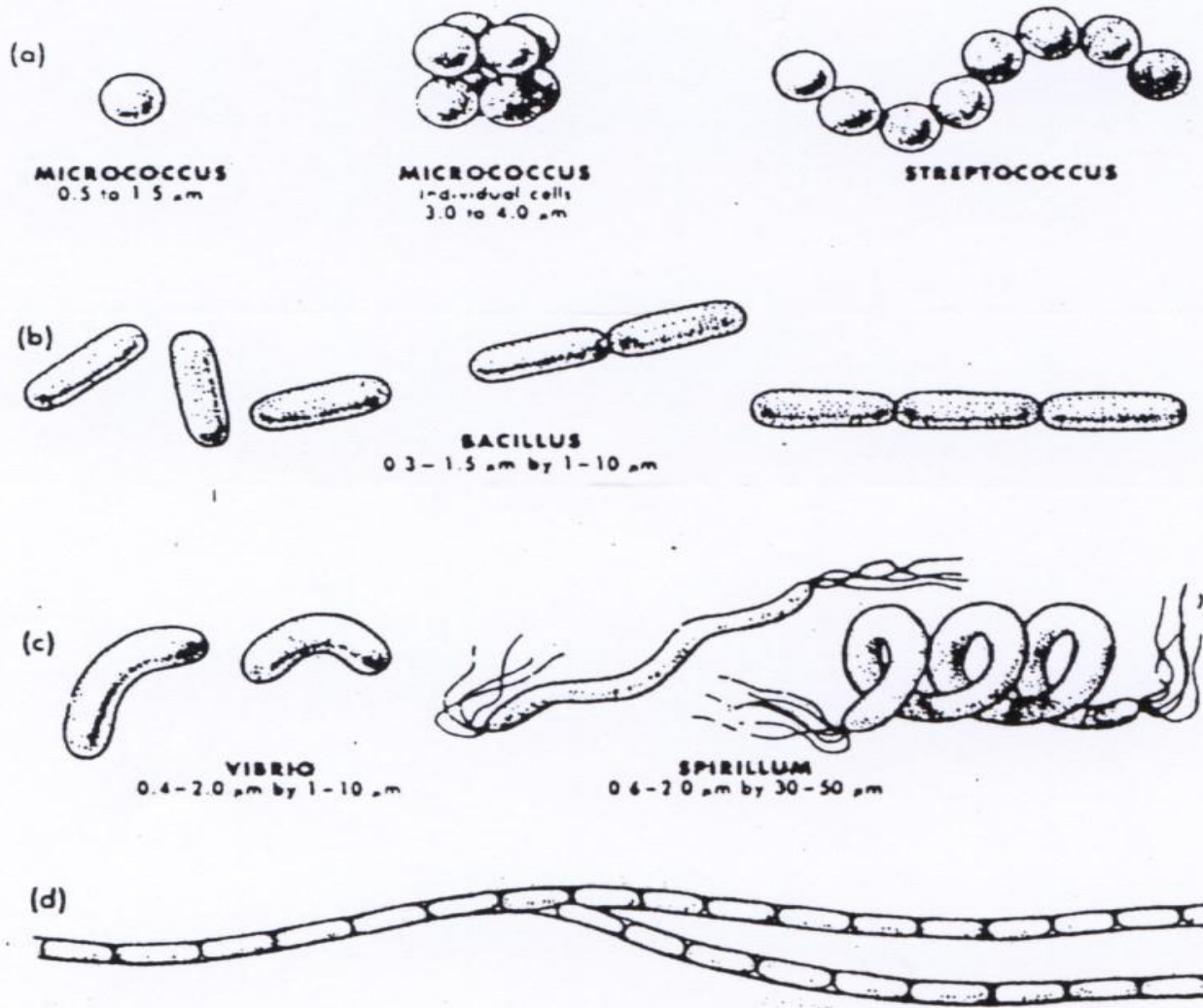
Different types of Protzoa  
(Animals-like behaviour, e.g. predation, motility)

# BACTERIA

- Small organisms with size between 0.5 – 5.0  $\mu\text{m}$
- Present individually, in pairs or in chains with different kinds of shapes 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** (Using photosynthesis or chemosynthesis)



# CLASSIFICATION OF BACTERIA (CONT.)

## ii. According to the utilisation of dissolved oxygen

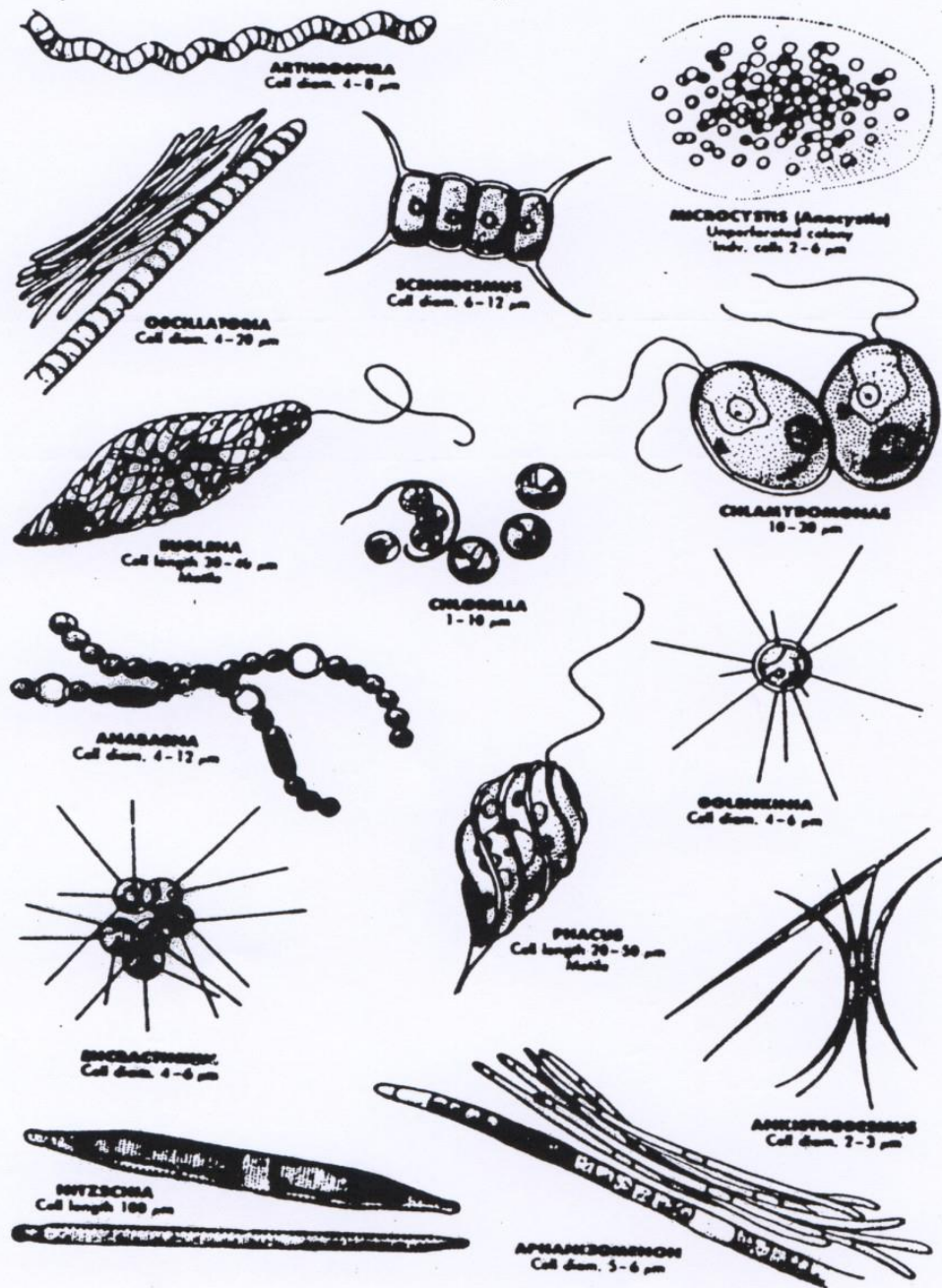
- Aerobe
  - USING DISSOLVED OXYGEN (DO) during the decomposition of organic compound
- Anaerobe
  - using oxygen in the form of different compound such as  $\text{NO}_3^-$ ,  $\text{SO}_4^{2-}$
- Facultative
  - able to survive in both of the above condition

# ALGAE

- Generate energy by photosynthesis (the process of harvesting light energy from the sun to generate carbohydrates).
- During the presence of sunlight, they increase the 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

## *Are Algae Plants or Animals ?*

**Algae** are photosynthetic creatures. They are neither **plant**, **animal** or **fungi**. Many **algae** are single celled, however some species are multicellular.



Representative algal species found in wastewater treatment ponds







◎ *To be continued ...*