

Chapter 2 Environmental Microbiology (Introduction)

Topics:

2-1 Metabolic classification of **microorganisms** (MO)

2-2 Biological Kinetics/ Enzyme kinetics

2-3 BOD

2-4 Application of microorganisms in wastewater treatment processes.

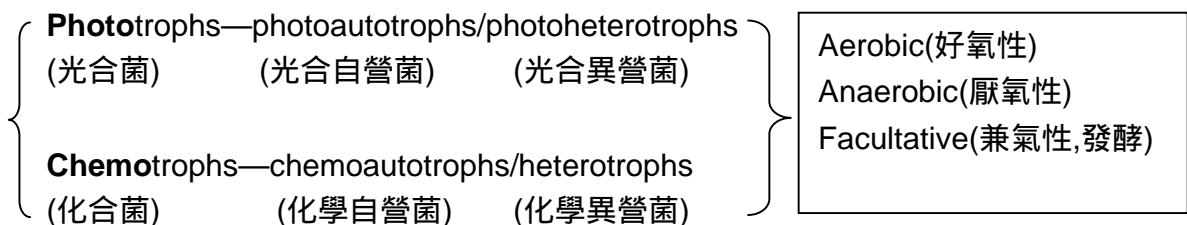
After this lecture, you are expected to explain:

1. What are the energy, carbon, and electron donor sources for different types of MO?
2. What's the difference between aerobic and anaerobic bacteria?
3. What's the difference between Michaelis-Menten Equation and Monod Equation?

And to know:

4. How to derive the Michaelis-Menten Equation?
5. How to derive the BOD equation based on mass balance?
6. Name typical MO related to wastewater treatment processes.

2-1 Metabolic classification of microorganisms (微生物的分類—依代謝方式)



- Criteria of classification:

Energy source, carbon source, electron donor(電子供應者), electron acceptor(電子接受者)

✓ Phototrophs: Light as energy source (以日光能做為能量來源之菌類)

1. Photo**autotrophs**: CO₂ as carbon source and H₂O, H₂ or H₂S as e⁻ donor (以二氧化碳作為碳源；水、氫、或硫化氫為電子供應者)，大部分為厭氧菌。

2. Photoheterotrophs: Organics as carbon source and electron donor (以有機物作為碳源及電子供應者), 皆為兼氣菌。

常見之 Photoautotrophs 有 Algae, cyanobacteria, photosynthetic bacteria (又稱 phototrophic bacteria), 他們進行之反應稱「無氧光合作用」(Anoxygenic photosynthesis):



Photoautotrophs: Purple sulfur bacteria, green bacteria

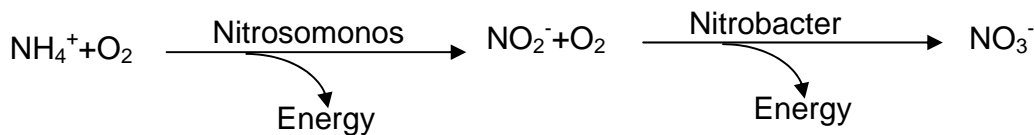
常見之 Photoheterotrophs 有 purple non-sulfur bacteria.

✓ Chemotrophs: chemicals both organic and inorganic as energy source (以化學能做為能量來源之菌類)

1. Chemo**auto**trophs: CO₂ as carbon source and Inorganics as energy source (以二氧化碳作為碳源; 無機物為能量來源), 大部分為好氧菌。
2. Heterotrophs: Organics as both carbon and energy source (以為有機物作為碳源及能量來源), 此類微生物自然界中最常見之菌種, 包含大部分之細菌類(Bacteria)、真菌(Fungi)、原生動物(Protozoa)。

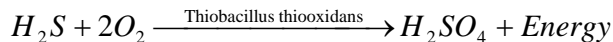
常見之 Chemoautotrophs 有:

- **Nitrifying bacteria:**



- **Sulfur-oxidizing bacteria** (pH ≤ 2, **acidphilic** bacteria 喜酸菌)

Utilize H₂S, S⁰, or S₂O₃²⁻ as energy source



Crown corrosion in sewers (下水道「皇冠」腐蝕)

- **Iron bacteria** → filamentous bacteria (絲狀菌)
Fe²⁺ as energy source + O₂ → Fe³⁺ + energy (水管土味惡臭)
- **Hydrogen bacteria:** H₂ as energy source, CO₂ as carbon source.

	Phototrophs		Chemotrophs	
	Photo auto trophs	Photoheterotrophs	chemo auto trophs	heterotrophs
Energy source	Light	Light	Inorganics	Organics
Carbon source	CO₂	Organics	CO₂	Organics
Oxygen demand	Anaerobic (mostly)	Facultative	Aerobic	Aerobic/anaerobic
Electron donor	H ₂ O, H ₂ , H ₂ S	Organics	Inorganics	Organics

Aerobic vs Anaerobic

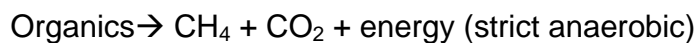
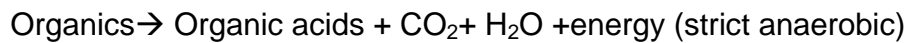
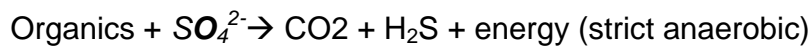
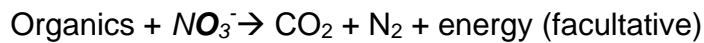
應用上 aerobic → 活性污泥法

anaerobic → 厭氧消化

- Aerobic reaction:



- Anaerobic reaction:



Energy Efficiency

