Basics of environmental microbiology

Soil Quality Lab
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Objectives

- ✓ **Studying basic knowledge about microbiology**
- ✓ **Understanding the way how microorganisms gain energy**
- ✓ **Understand the overall principle of the experiment**

- References

Environmental Biotechnology (Rittmann, McCarty)
Lehninger 9Principles of Biochemistry (Nelson, Cox)

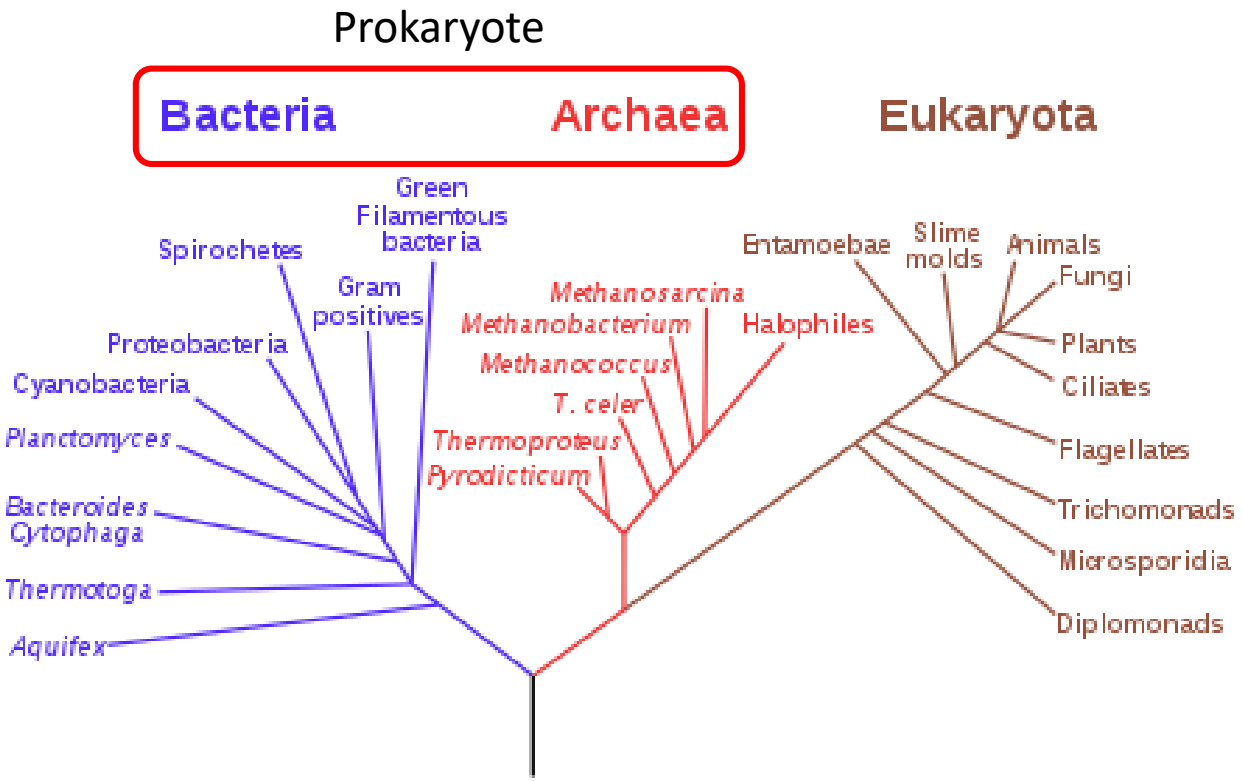
Domain_Bacteria, Archaea, Eukaryote

- ✓ Environmental engineering mainly focuses on bacteria and archaea

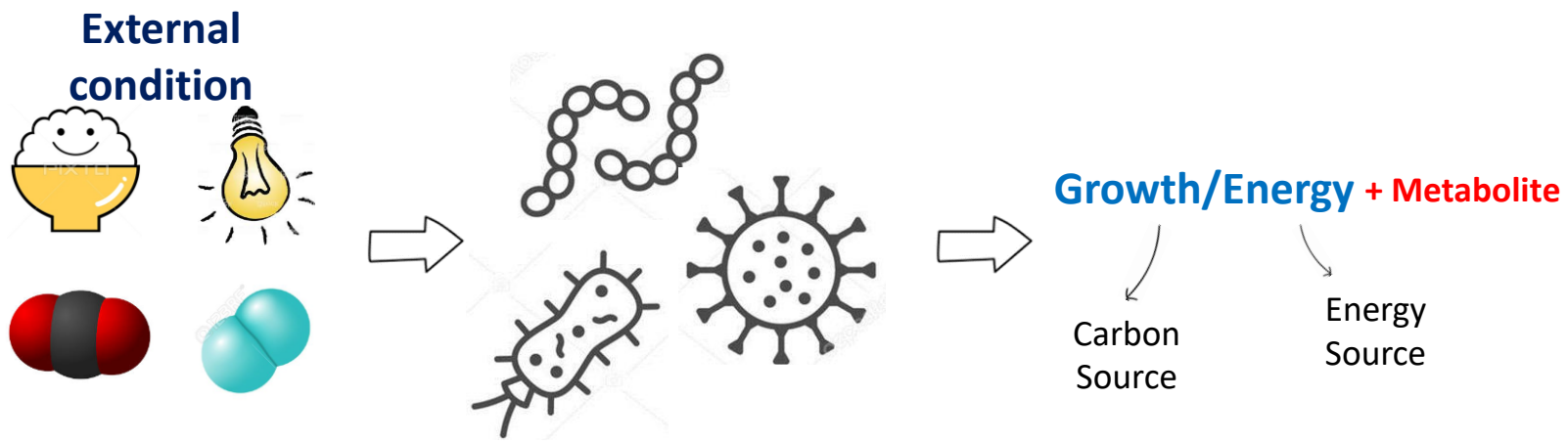
  : Eukaryotes are difficult to manipulate and achieve stable efficiency.

- ✓ Both bacteria and archaea are unicellular organisms

  :there are structural and functional differences.



Classification of bacteria



- **Energy source**

  Phototroph: use photon as energy source

  Chemotroph: use chemical substances
  - Chemoorganotroph (organic substances)
  - Chemolithotroph (inorganic substances)

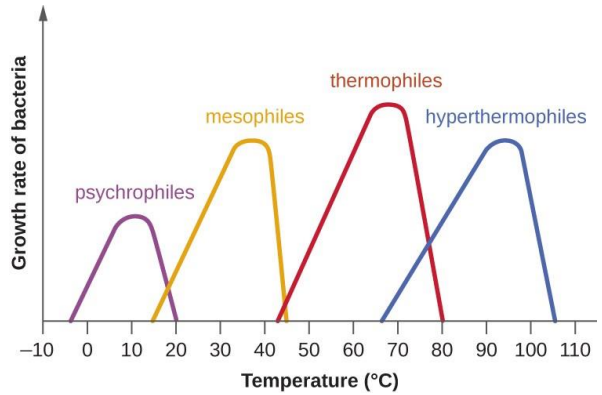
- **Carbon source**

  Autotroph: uses inorganic carbon, most of the chemolithotrophs and phototrophs

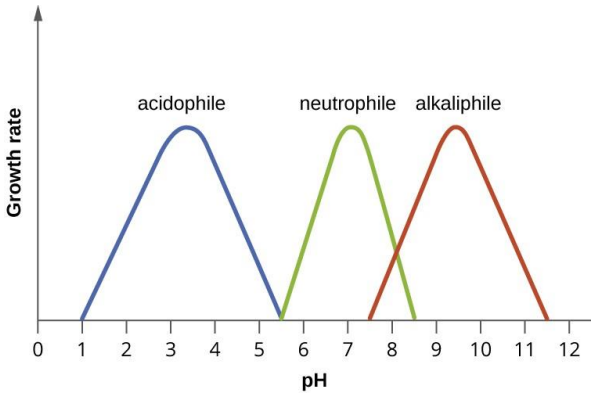
  Heterotroph: uses organic carbon, usually chemoorganotrophs

Classification of bacteria

❖ **Temperature**



❖ **pH**



❖ **Oxygen**

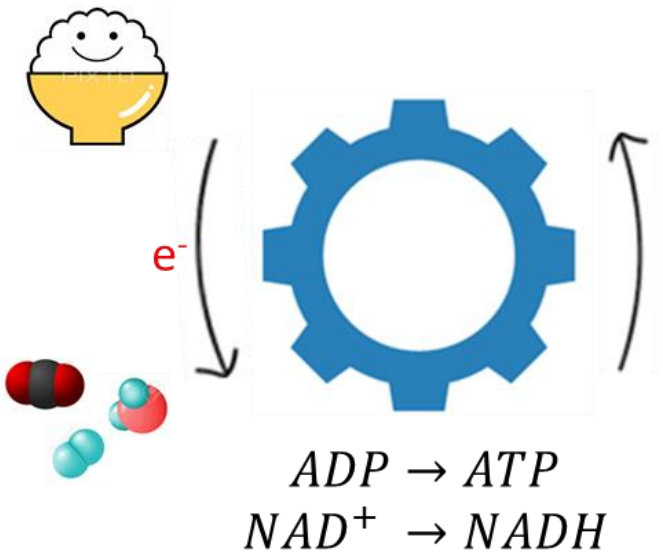
- Aerobic bacteria: Requires oxygen for growth, and uses oxygen as the electron acceptor
- Facultative: Can survive with or without oxygen

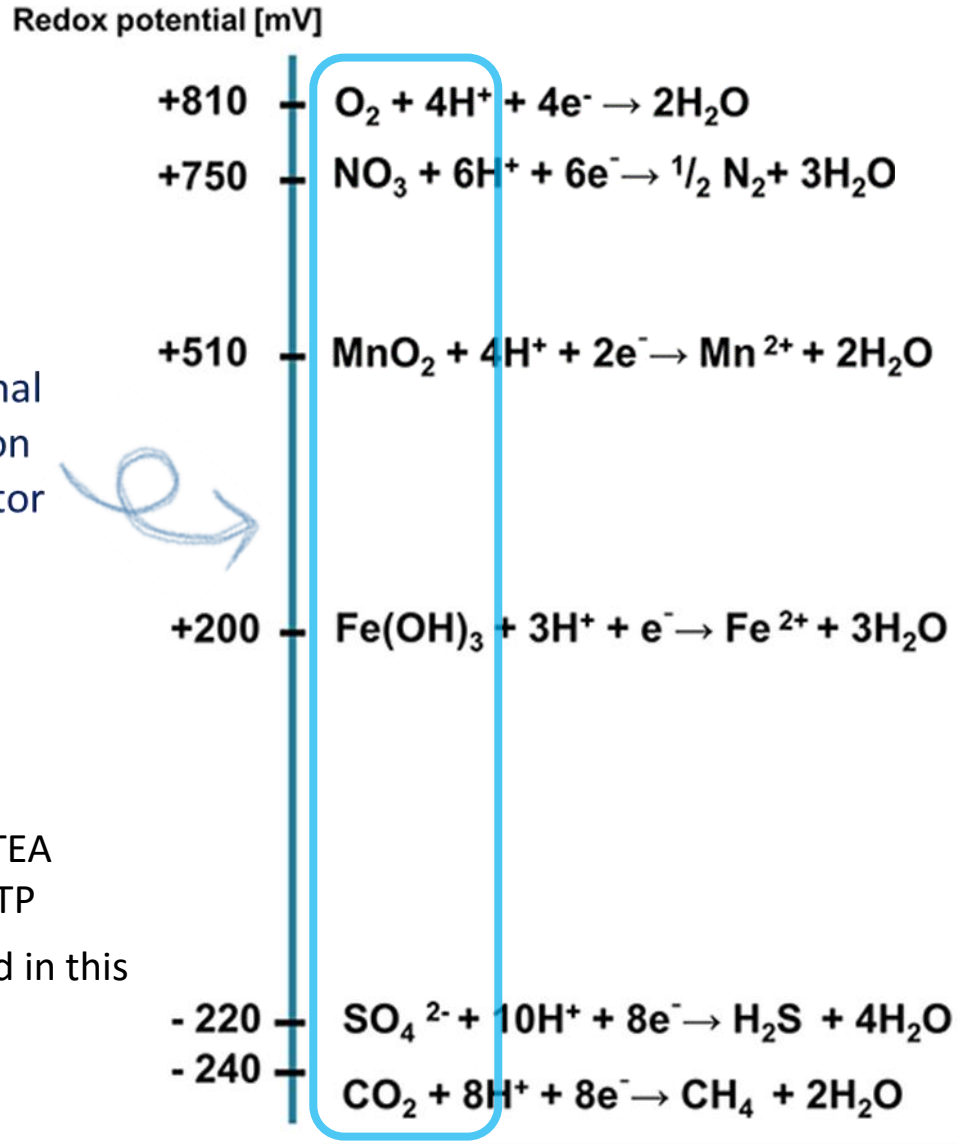
→ Aerotolerant anaerobes: Do not use oxygen, but do not die under aerobic condition
Facultative aerobes: Prefer to use oxygen as electron acceptor, but can survive w/o oxygen

- Obligate anaerobes: Got killed by oxygen

❖ **+ Salinity, etc**

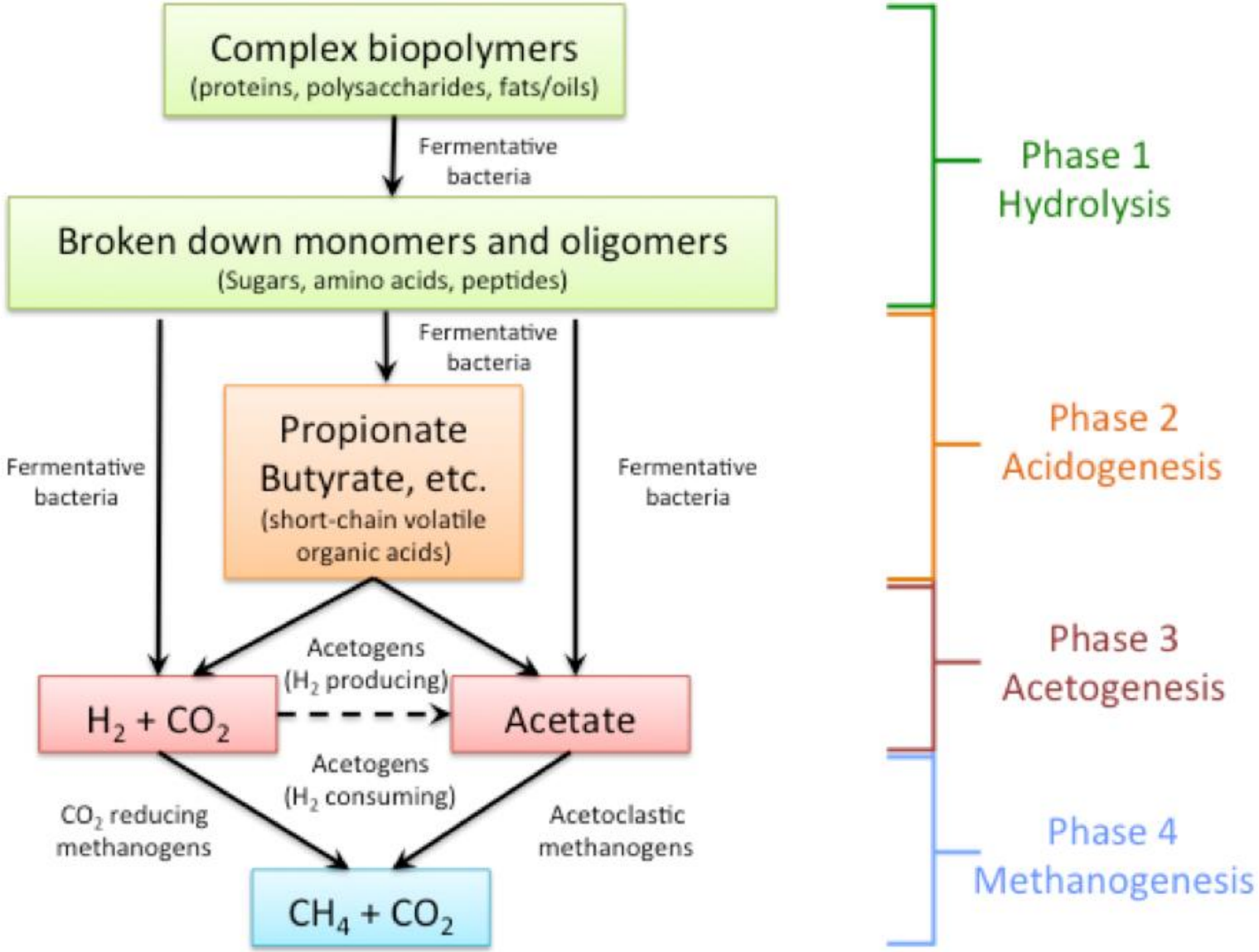
Energy Capture





- Microbes got energy through oxidation reduction reaction
- Got electron by oxidizing organics, and TEA finally takes the electron and produce ATP
- Electron and energy carriers are involved in this process

Interaction of the microbes



Microbial Ecology

- ✓ **What microorganisms are present?** → Community structure
- ✓ **What metabolic reactions could the microorganisms carry out?**
- ✓ **What reactions are they carrying out?**

Community Function

- ✓ **How are the different microorganisms interacting with each other and the environment?** → Interaction

Engineers create and operate the system **(bioreactor, selection pressure)** in which right kinds of microorganisms are present **(community structure)**, they are accumulated to quantities sufficient to complete a desired biochemical task **(community function)**, and they work together to perform their tasks stably over time **(integrated community ecology)**.

Keyword: Ecological Niche, Functional Redundancy, Acclimation, Adaptation