

Chapter 6 – Microbial Growth and Nutrition

1. Describe the role of carbon, hydrogen, oxygen, nitrogen, trace elements, and vitamins in microbial growth.

- **Carbon** is used as an energy source for most organisms.
- A **hydrogen** source is needed to conduct redox reactions.
- **Nitrogen** is a component in proteins and nucleotides.
- **Oxygen** is needed to survive, while obligate anaerobes cannot process oxygen.
- **Trace elements** are those elements that are required in small quantities.
- **Vitamins** are known as growth factors and can also act as cofactors.

2. Compare the four basic categories of microorganisms based on their carbon and energy sources

		Energy source	
		Light (photo-)	Chemical compounds (chemo-)
Carbon source	Carbon dioxide (auto-)	Photoautotrophs - Plants, algae, and cyanobacteria use H_2O to reduce CO_2, producing O_2 as a by-product - Green sulfur bacteria and purple sulfur bacteria do not use H_2O nor produce O_2	Chemoautotrophs Hydrogen, sulfur, and nitrifying bacteria, some archaea
	Organic compounds (hetero-)	Photoheterotrophs Green nonsulfur bacteria and purple nonsulfur bacteria, some archaea	Chemoheterotrophs - Aerobic respiration: most animals, fungi, and protozoa, and many bacteria - Anaerobic respiration: some animals, protozoa, bacteria, and archaea - Fermentation: some bacteria, yeasts, and archaea

3. Distinguish aerobes, anaerobes, aerotolerant anaerobes, facultative anaerobes, and microaerophiles.

- **Anaerobes** cannot be exposed to oxygen compounds, while **aerobes** require oxygen for survival.
- **Aerotolerant anaerobes** do not use aerobic metabolism, but can be exposed to oxygen.
- **Microaerophiles** are the organisms that require 2-10% of oxygen but cannot tolerate any more.
- **Facultative anaerobes** utilize anaerobic respiration or fermentation, in order to survive without oxygen.

4. Explain how oxygen can be fatal to organisms, and how organisms protect themselves from toxic forms of oxygen

- Oxygen can be fatal due to its reactive forms, it is a great oxidizing agent and steals electrons.
- Organisms can protect themselves from these forms of oxygen through detoxifying them with enzymes. Things like carotenoids, superoxide dismutase (aerobic enzyme).

5. Describe nitrogen fixation and discuss its importance.

- **Nitrogen Fixation:** Process in which nitrogen (N_2) is reduced to ammonia (NH_3).
- Nitrogen fixation is essential for life because it provides nitrogen in a useable form for other organisms.