

# Lecture-10

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## Nutrition and Cell Chemistry

# Nutrition and Cell Chemistry

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- Definitions
- Macronutrients
- Micronutrients

# Mode of living in microorganisms

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**Microorganisms** can be divided into two categories:

**Autotrophic** : They can build up complex organic substances such as carbohydrates from simple inorganic sources (CO<sub>2</sub> and water).

**Heterotrophic** : They cannot build up carbohydrates from simple inorganic sources.

They depend on ready made organic materials derived from plants animals and humans. They can live on such compounds, break it down enzymatically.

Heterotrophic microorganisms can be divided into :

**Parasites** on plants, animals and humans causing serious diseases.

**Saprophytes** on dead organic matter.

**Symbionts** with other living organisms sharing benefits.

# Nutrition and Cell Chemistry

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- Before a cell replicates, it must coordinate many different chemical reactions and organize many different molecules into specific structures.
- These reactions are called metabolism.
- Most knowledge of microbial metabolism is based on study of laboratory cultures.

## **Metabolism**

- The sum total of all chemical reactions that occur in a cell

## **Catabolic reactions (catabolism)**

- Breaks molecular structures down and releasing energy

## **Anabolic reactions (anabolism)**

- Energy-requiring metabolic reactions, using energy to build larger molecules from smaller ones.

# Nutrition and Cell Chemistry

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- Nutrition is a part of microbial physiology that deals with the nutrients required for growth.
- Different organisms need different complements of nutrients and NOT all nutrients are required in the same amount.
- All microbial nutrients are compounds constructed from the chemical elements .
- **Nutrients**
  - Supply of monomers required by cells for growth
- **Macronutrients**
  - Nutrients required in **large** amounts
- **Micronutrients**
  - Nutrients required in **trace** amount

# Major Macronutrients

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- besides water , Carbon , Hydrogen, Oxygen and Nitrogen constitute an important requirements an the bulk of a living organism.

## Carbon

- Required by all cells
- Typical bacterial cell ~50% carbon (by dry weight)
- Major element in all classes of macromolecules
- Heterotrophs use organic carbon
- Autotrophs use inorganic carbon

# Major Macronutrients

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## Nitrogen

- Required by all cells
- Typical bacterial cell ~14% nitrogen (by dry weight)
- Key element in proteins, nucleic acids, and many more cell constituents
- Many bacteria meet the nitrogen requirement by decomposing protein-containing material
- Other bacteria use nitrogen from ammonia (NH<sub>3</sub>).
- Some bacteria can also use nitrate ion NO<sub>3</sub><sup>-</sup>.
- Important bacteria can use gaseous nitrogen N<sub>2</sub> directly from atmosphere in a process called nitrogen fixation

# Macronutrients

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- *Phosphorus (P)*
  - Synthesis of nucleic acids and phospholipids
  - Found in the energy bonds of ATP the molecule that storage and transfer chemical energy with in the cell
- *Sulfur (S)*
  - **Sulfur-containing** amino acids (cysteine and methionine)
  - **Vitamins** (e.g., thiamine, biotin, lipoic acid) and coenzyme A.
- *Potassium (K)*
  - Required by enzymes for activity



# Macronutrients

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- Magnesium (Mg)
  - Stabilizes ribosomes, membranes, and nucleic acids
  - Also required for many enzymes
- Calcium (Ca)
  - Helps stabilize cell walls in microbes
  - Plays key role in heat stability of endospores
- Sodium (Na)
  - Required by some microbes (e.g., marine microbes)

# Micronutrients

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## □ Iron

- Key component of cytochromes and iron-sulfer (FeS) proteins involved in electron transport
- Iron under **anoxic** conditions (no O<sub>2</sub>): generally in the ferrous (Fe<sup>2+</sup>) form and soluble
- Iron under **oxic** conditions (with O<sub>2</sub>): generally in the ferric (Fe<sup>3+</sup>) form and exists as insoluble minerals
- Cells produce siderophores (iron-binding agents) to obtain iron from insoluble mineral form

□ Some micronutrients needed by microorganisms : Boron ,chromium ,Cobalt , Copper ,  
Manganese, Molybdenum ,Zinc .

# Growth Factors

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- **Growth Factors:** Organic compounds required in small amounts by certain organisms.
  - **Examples:** vitamins, amino acids, purines, pyrimidines
- Most microorganisms are able to biosynthesize the growth factors they need , some must obtain one or more of them from environment .
- **Vitamins** are most commonly required growth factors
  - Most function as co-enzymes which are the nonprotein components of enzymes

ANY  
QUESTIONS  
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