

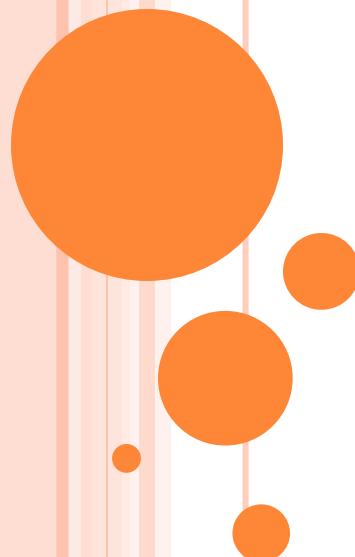
BACTERIAL PHYSIOLOGY

Year

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Lec. ١

Nutrition and Metabolism



₹ -Bacterial Nutrition

- constitutes 10% of the total weight of bacterial cells.
- Proteins, polysaccharides, lipids, nucleic acids & low molecular weight compounds make up the remaining 10%.
- For growth & multiplication, the minimum nutritional requirements are water, a source of carbon, a source of nitrogen & some inorganic salts



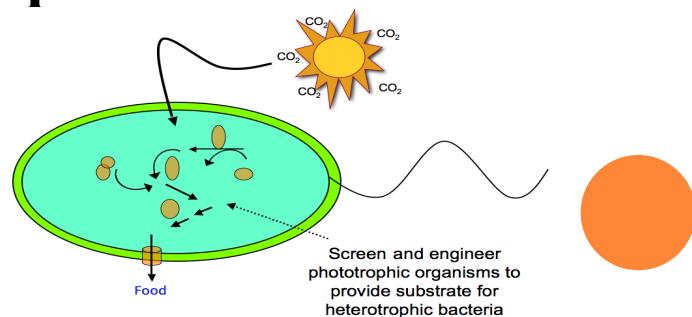
Classification based on nutrition:

Based on nutrition , bacteria are classified as :

Autotrophs – can synthesize all their organic compounds by utilizing atmospheric CO₂ & N₂. They have no medical importance.

Heterotrophs – unable to synthesize their own metabolites & depend on the organic compounds.

All pathogenic bacteria are heterotrophs .



Nutritional Factors

Some bacteria require certain organic compounds in minute quantities called as nutritional factors .

It can be :

Essential – Compounds that bacterial growth does not occur in their absence.

Accessory – Compounds that enhance growth but without being absolutely necessary for it.

Based on Nutritional Requirement Bacteria Can Be Classified As:

Phototrophs – Bacteria which derive their energy from sunlight.

Chemotrophs – Bacteria which derive energy from chemical reactions

Organotrophs : require organic sources of hydrogen

Lithotrophs : require inorganic sources of hydrogen like NH_4^+ , H_2S



○ **OTHER GROWTH REQUIREMENTS:**

- Vitamin B complex –
- Thiamine
- Riboflavine
- Nicotinic acid
- Pyridoxine
- Folic acid
- Vit.B ۱۲

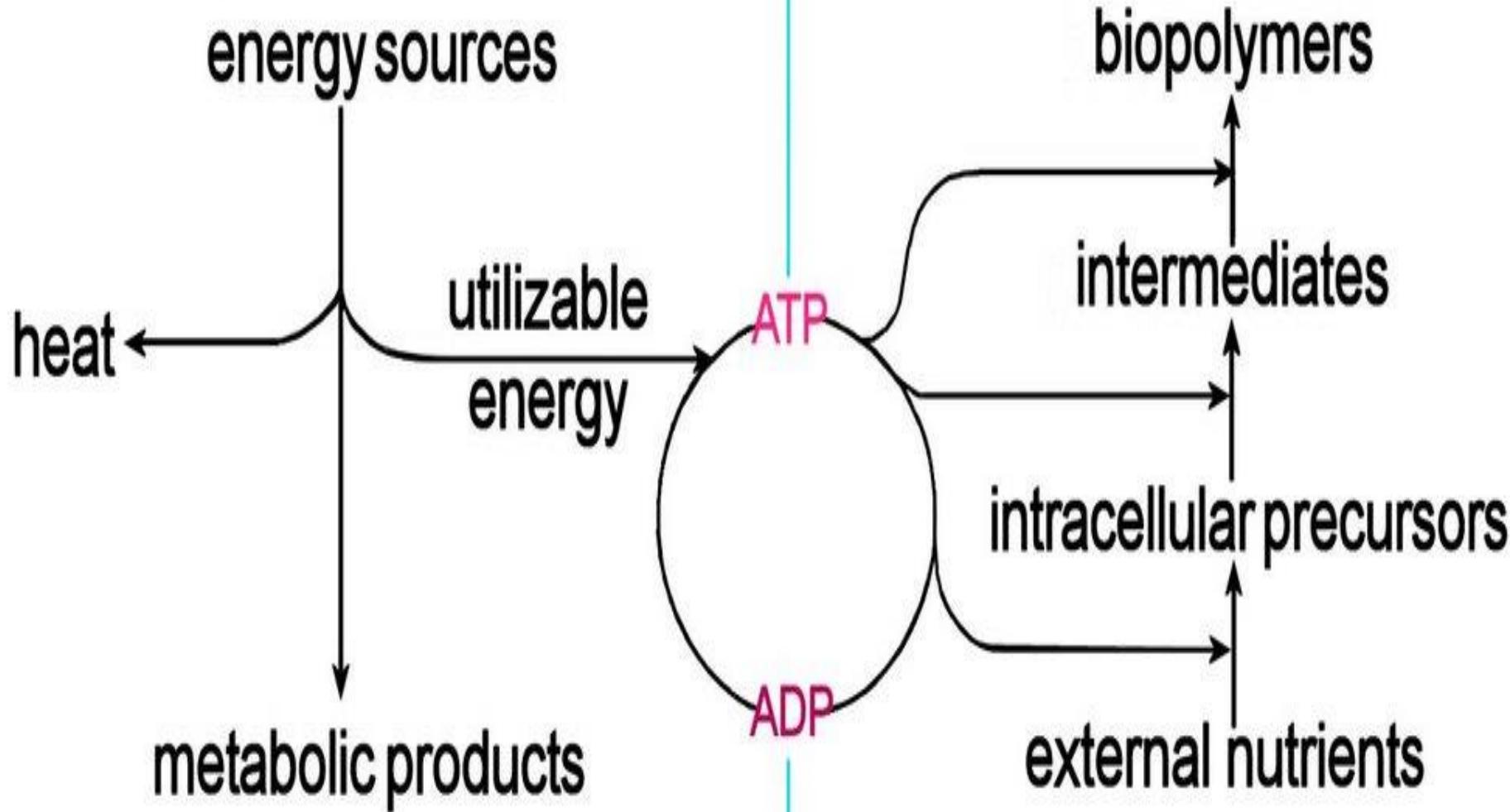


₹ -Bacterial Metabolism

- Types of Metabolism:
- Metabolism is the totality of chemical reactions occurring in bacterial cells.
- They can be subdivided into :
 - **A- Catabolic** reactions that supply energy.
 - **B- Anabolic** (synthetic) reactions that consume energy
- **Catabolic reactions** supply both energy and the basic structural elements for the synthesis of specific bacterial molecules.
- **-In the anabolic reactions** , the energy requirement is consumed in form of light or chemical energy—by photosynthetic or chemosynthetic bacteria, respectively.

Catabolism

energy-yielding metabolism



Anabolism

biosynthetic metabolism

○ **A-Catabolic Reactions:**

- -Organic nutrient substrates are catabolized in a wide variety of enzymatic processes that can be schematically divided into three phases:

○ **γ -Digestion:**

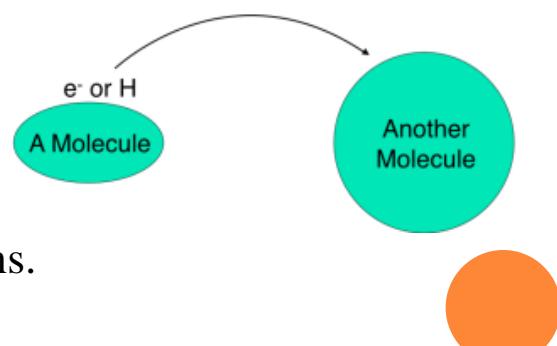
- -Bacterial exoenzymes split up the nutrient substrates into smaller molecules outside the cell.
- The exoenzymes represent important pathogenicity factors in some cases.

○ **γ -Uptake:**

- -Nutrients can be taken up by means of passive diffusion or, more frequently, specifically by active

○ **γ -Oxidation:**

- -This process is defined as the removal of electrons and H⁺ ions.
- -The substance to which the H⁺ atoms are transferred is called the hydrogen acceptor.



-The two basic forms of oxidation are defined by the final hydrogen acceptor:

A – Respiration:

-A series of reactions that convert glucose to CO_2 and allow the cell to recover significant amounts of energy

- Glucose + $\text{O}_2 \rightarrow$ Carbon dioxide + Water +Energy

- $\text{C}_6\text{H}_{12}\text{O}_6 + \text{O}_2 \rightarrow 6\text{CO}_2 + 6\text{H}_2\text{O} + 38\text{ ATP}$

B-Fermentation:

-Here an organic compound serves as the hydrogen acceptor.

-The main difference between fermentation and respiration is the energy yield, which can be greater from respiration than from fermentation for a given nutrient substrate by as much as 10 times



- **B-Anabolic Reactions;**
- -Some bacteria (like E. coli) are capable of synthesizing all the complex organic molecules that they are comprised of from the simplest nutrients in a very short time. These capacities are utilized in the field of microbiological engineering.
- -Some bacteria are capable of using hydrocarbon compounds as an energy source.



End

