METABOLISM

BIO - 3.1

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Recommended books

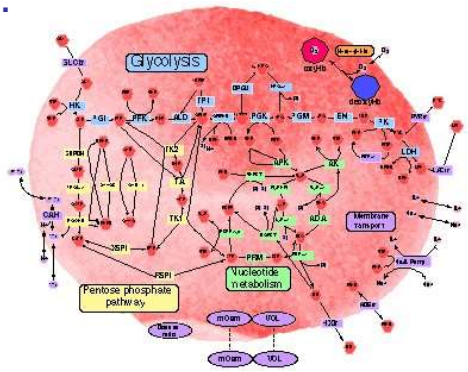
D.L. Nelson et M.M. Cox. Lehninger Principles of Biochemistry. Fourth Edition, W.H. Freeman and Company. 2004

S. Desagher. Métabolisme: Approche physico-chimique. Ellipses, 1998

DEFINITIONS

Metabolism:

- **Set of life-sustaining chemical transformations within the cells of living organisms.**



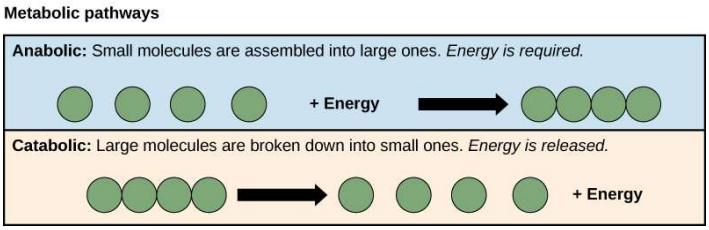
- **Recover energy**
- **Construct molecules that make cells (proteins, lipids, nucleic acid and some carbohydrates, etc)**
- **Elimination of wastes.**

These enzyme-catalyzed reactions allow organisms to grow and reproduce, maintain their structures, and respond to their environments.

DEFINITIONS

Metabolism is divided in two main processes:

- **Anabolism: Reactions that lead to the synthesis of molecules required by the cell. Energy used in anabolic reaction is provided by catabolism.**
- **Catabolism: Reactions that lead to degradation of biologic molecules into simple ones and finally into CO_2 *in vivo* allowing their excretion and releasing energy.**

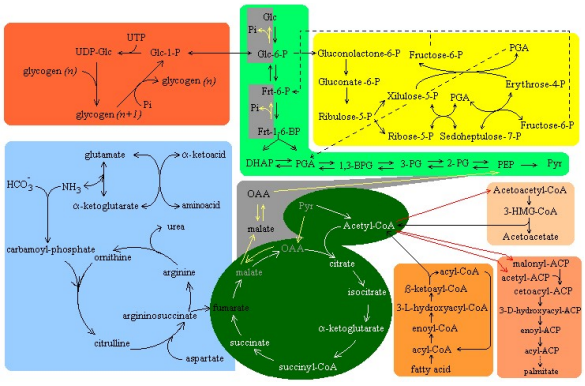


GENERAL PRINCIPLE

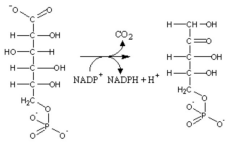
- A metabolism is a sequence of chemical reaction catalyzed by enzymes.

- A reaction or group of reactions catalyzed by sole enzyme is a step (link) on a metabolic pathway.

Metabolic pathways



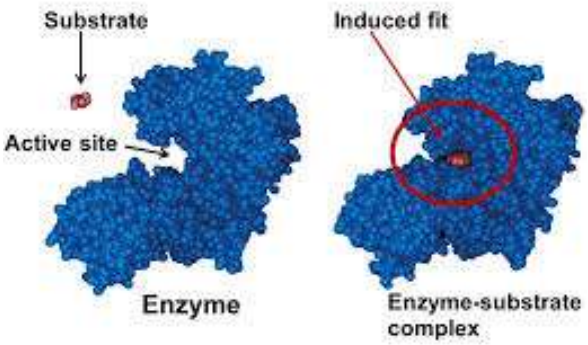
A metabolic step
(here involving two reactions)



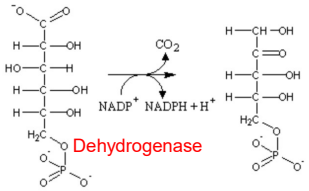
Dehydrogenase
(only one enzyme)

Enzyme : a globular protein that catalyzes a biological chemical reaction

The enzyme:

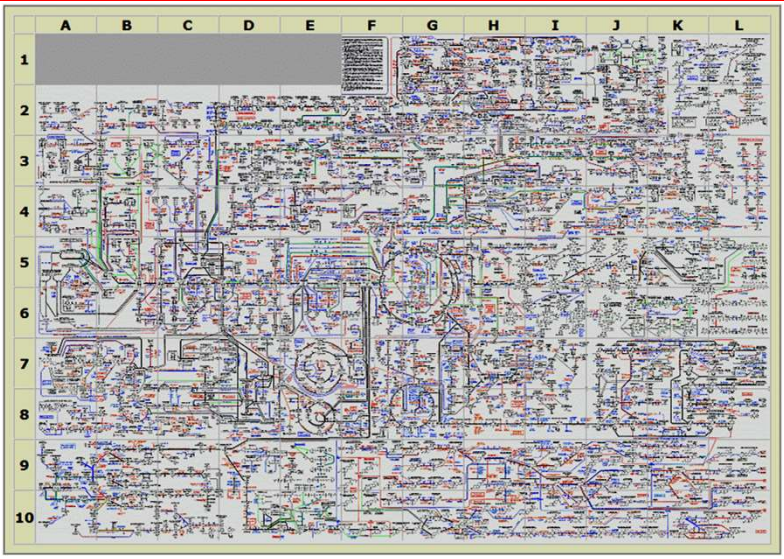


One step and two reactions:



Oxidation and skeleton brake

Plus d'un millier de réactions chimiques dans un organisme vivant.



-When several cell compartments are involved, the metabolites are carried between compartments by transport proteins.

- **Several steps in common to different pathways.**

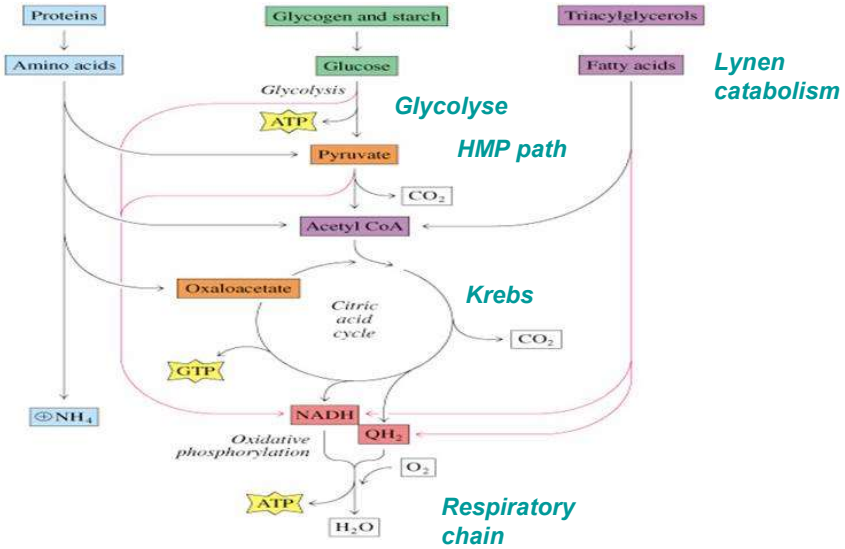
- **Similarities between diffents living organisms:**

  ✓ **The basic metabolic pathways are common to all organisms**

  ✓ **However, there are functional differences among them**

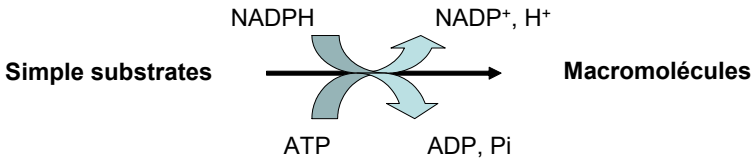
MAIN CATABOLIC PATHWAYS

➢ **Energetic catabolism (NAD^+ oxidation dependent)**



ANABOLIC PATHWAYS (catabolic similarities)

- Anabolism of aerobic systems generally involves reduction reactions using NADPH as cofactor :



- Energy is provided by ATP hydrolysis.
- Macromolecules are synthetized from intermediary metabolites :
- The essential source of carbon is glucose.

The metabolic reactions

The study of metabolism has shown, with some exceptions, that most metabolic steps *in vivo* involve one, or a combination, of 5 principal types of simple chemical simple reactions

Major processes :

Oxidation / reduction
Hydrolysis / condensation
Synthesis / C-skeleton brake

Minor processes:

Cetoenolic tautomery
Hydration / dehydration

(1) The major processes involved in a metabolism can be predicted by looking to the substrate and the final product.