

**Biochemistry**

Code: 102522  
ECTS Credits: 6

Degree	Type	Year	Semester
2502444 Chemistry	OB	3	2

**Contact**

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**Use of languages**

Principal working language: catalan (cat)  
Some groups entirely in English: No  
Some groups entirely in Catalan: Yes  
Some groups entirely in Spanish: No

**Teachers**

Maria Plana Coll  
Alicia Roque Cordova

**Prerequisites**

There are no official prerequisites. However, it is assumed that the student has acquired the knowledge given in the first year subject of Fundamentals of Molecular and Cell Biology, especially those referring to enzymology and the structure and function of glucides, lipids, proteins and nucleic acids .

**Objectives and Contextualisation**

Context and objectives

The subject Biochemistry continues and complements a part of the contents given in the subject "Fundamentals of Molecular and Cell Biology". In the Biochemistry subject, the basic aspects of the metabolic pathways, the associated energy changes, their physiological significance, their interconnections and their response to biological signals are studied from a basic and general point of view.

The general objective of the subject is to provide an overview of the metabolism in living beings, as well as their regulation

Specific objectives of the subject are:

- To describe the general mechanisms through which living organisms obtain and transform the energy of the environment.
- To know the main molecular mechanisms for the transduction of biological signals.
- To describe the central pathways of the metabolism of glucides, lipids, amino acids and nucleotides.
- To know the components of the electronic transport chains, oxidative phosphorylation or photophosphorylation, and obtention of metabolic energy.

- To give an overview of the interconnections between the metabolic pathways, as well as the mechanisms that regulate them in a coordinated way and the changes in various physiopathological situations.
- To know how to apply the knowledge studied to solve qualitative and quantitative problems.

## Content

### THEORY

#### Topic 1. Basics of metabolism.

Concept of metabolism and metabolic pathway. Experimental methods for the study of metabolism. Phases of metabolism. Free energy of biological processes. Coupled reactions. Role of ATP and other phosphorylated compounds in metabolism. Oxido-reductions in biochemical processes. Paper of the electron transporters in the metabolism.

#### Topic 2. Basic concepts of metabolic regulation.

Regulation of enzymatic activity. Allosteric enzymes. Regulation by covalent modification. General aspects of the regulation of gene expression. Control and compartmentalisation of metabolic pathways.

#### Topic 3. Biosignaling.

Hormones, neurotransmitters and other primary messengers. Membrane and intracellular receptors. Molecular mechanisms of signal transduction. Integration of effects at the cytoplasmic and nuclear level.

#### Topic 4. Glucid metabolism.

Degradation of glucose: glycolysis and pentose phosphate pathway. Fermentation. Gluconeogenesis. Synthesis and degradation of glycogen. Use of other glucides. Coordination in the control of the metabolism of glucose and glycogen: importance of the metabolic specialization of tissues.

#### Topic 5. Central routes of oxidative metabolism.

Metabolic pathways leading to the formation of acetyl-CoA. The complex of the pyruvate dehydrogenase. Cycle of the citric acid. Energy performance and regulation. Anaplerotic reactions. Amphibolic nature of the cycle: connections with biosynthetic pathways. Glioxylate cycle.

#### Topic 6. Electronic transport and oxidative phosphorylation.

Mitochondrial electronic transport chain. Origin and use of reduced substrates. Chemiosmotic coupling: ATP synthase and oxidative phosphorylation. Mitochondrial transport systems. Regulation of oxidative phosphorylation. Energy balance of oxidative metabolism (example of glucose). Decoupling proteins and thermogenesis.

#### Topic 7. Photosynthesis.

Basic process of photosynthesis. Photosynthetic pigments. Absorption of the energy of light. Electronic transport and photophosphorylation. Assimilation of CO<sub>2</sub> and photosynthesis. Biosynthesis of glucides (Calvin cycle). Regulation of photosynthesis. Photorespiration and C<sub>4</sub> cycle.

#### Unit 8. Metabolism of lipids.

Use of triacylglycerols in animals. Metabolism of lipoproteins. Description and regulation of the oxidative pathway of fatty acids. Ketogenesis. Description and regulation of the biosynthetic pathway of fatty acids. Biosynthesis of triacylglycerols and phospholipids. Cholesterol metabolism and its derivatives.

Unit 9. Metabolism of nitrogen compounds: Metabolism of amino acids and nucleotides.

Nitrogen cycle. General characteristics of the synthesis and degradation of amino acids. Destination of carbon atoms of amino acids. Elimination of ammonia and urea cycle. Synthesis of amines of biological interest. Formation of creatine and phosphocreatine. General characteristics of the metabolism of purine and pyrimidine nucleotides. Synthesis of deoxyribonucleotides: regulation of ribonucleotide reductase. Biomedical applications of nucleotide analogues: AIDS, cancer.

Topic 10. Integration of metabolism.

Metabolic specialization of tissues. Metabolic characteristics of liver, muscle and adipose tissue. Metabolic adaptations to various physiopathological situations: Changes associated with the various nutritional states, the exercise and the effects of stress. Metabolic Alterations to Diabetes. Obesity Metabolic abnormalities in cancer. Biotransformation and drug detoxification.

## PROBLEMS

The problems refer to some aspects of the Theory program. The own characteristics of the various parts of the Theory's agenda make the statements of the problems concentrate on certain aspects, such as the enzymatic reactions (oxidation-reduction, transfer of chemical group, etc.) that constitute the various stages of metabolism, its regulation in response to the activation of different signaling pathways and the importance in various physiopathological conditions.

## LABORATORY PRACTICES

There will be two laboratory sessions of four hours each:

- 1) Process of expression of a heterologous protein.
- 2) Process of expression of a heterologous protein (analysis of results). Determination of an enzymatic activity by monitoring a spectrophotometric signal. Determination of kinetic parameters under steady state conditions.