

Biosignalling and Metabolism

Code: 100759
ECTS Credits: 6

Degree	Type	Year	Semester
2500250 Biology	FB	2	1

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

Other comments on languages

Classes will be in Catalan, but part of the graphic material and the bibliography will be in English or Spanish.

Teachers

Ana Paula Candiota Silveira
Julia Lorenzo Rivera

Prerequisites

There are no official prerequisites. However, it is assumed that the student has acquired the knowledge taught in the subjects of the first year of the degree of Biology, in particular the contents of the subjects of Chemistry, Cell Biology and especially those of Structure and function of Biomolecules, such as those referring to principles of bioenergetics, enzymology, structure and function of carbohydrates, lipids, proteins and nucleic acids.

Objectives and Contextualisation

The subject Biosignalling and Metabolism constitutes the second part of the subject "Biochemistry" of the Degree of Biology and deals with the processes that determine the functioning of the living organisms in each one of their levels of organization from a basic and general point of view, as it corresponds to a second course subject. The general objective of the subject is to describe at the molecular level the signal transduction mechanisms, as well as the main metabolic pathways and their regulation and coordination. It has the goal of providing the basics of the molecular and metabolic aspects and concepts necessary for the follow-up of various subjects of the Degree in Biology.

Specific objectives of the subject:

- Knowledge about the main molecular mechanisms of signal transduction.
- Describe the main pathways of the intermediate metabolism of carbohydrates, lipids and nitrogen containing compounds, their regulation and coordination.
- Describe the components of the electronic transport chain, its coupling with the oxidative phosphorylation and the production of metabolic energy.
- Describe photosynthesis and its regulation.
- Describe the integration of metabolism with special emphasis on mammals.
- Know how to apply the knowledge acquired 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 in biological processes. Coupled reactions. Role of ATP and other phosphorylated compounds in metabolism. Oxide-reductions in biochemical processes. Role of the electron transporters in 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. Biosignalling.

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. Carbohydrate metabolism.

Degradation of glucose: glycolysis and of pentose phosphate pathway. Fermentation. Gluconeogenesis. Synthesis and degradation of glycogen. Use of other carbohydrates. 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.

Production of acetyl-CoA. The citric acid cycle. Energy balance and regulation. Anaplerotic reactions. The glyoxylate cycle.

Topic 6. Electronic transport and oxidative phosphorylation

Mitochondrial electronic transport chain. Origin and use of reduced substrates. Chemosmotic coupling: ATP synthase and oxidative phosphorylation. Mitochondrial transport systems. Regulation of oxidative phosphorylation. Energy balance of oxidative metabolism.

Topic 7. Photosynthesis.

The basic process of photosynthesis. Photosynthetic pigments. Absorption of light energy. Electronic transport and photophosphorylation. Assimilation of CO₂ and photosynthetic biosynthesis of sugars (Calvin cycle). Regulation of photosynthesis. Photorespiration and C₄ cycle.

Topic 8. Lipid metabolism.

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

Topic 9. Metabolism of nitrogen containing compounds.

The nitrogen cycle. General characteristics of the synthesis and degradation of amino acids. Metabolic fate of the carbon skeleton of amino acids. Removal of ammonia and the urea cycle. General characteristics of the metabolism of the nucleotides. Biomedical applications of nucleotide analogues: AIDS, cancer.

Topic 10. Integration of metabolism.

Specific tissue metabolism. Coordination between the metabolisms of the liver, muscle (skeletal and cardiac), adipose tissue and brain. Main regulatory hormones. Stress and adaptations of metabolism.

PROBLEMS

The problems will focus on some aspects of the theory program. Problems will concentrate on certain aspects, such as the enzymatic reactions of oxidation-reduction, transaminations, etc, due to the particular characteristics of the different parts of the theory program. A dossier with the formulation of the problems will be delivered through the Virtual Campus of the subject.

LABORATORY PRACTICES

There will be two sessions of 4 hours each one:

- 1- Measurement of the enzymatic activity of pyruvate kinase in rat muscle and liver.
- 2- Extraction and identification of the lipids present in food.

The protocols and questionnaires will be delivered through the Virtual Campus of the subject and students will have to print and bring them to the first practical session.