Universitat Autònoma de Barcelona

2019/2020

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.

Competences

- Apply statistical and computer resources to the interpretation of data.
- Be able to analyse and synthesise
- Be able to organise and plan.
- Carry out functional tests and determine, assess and interpret vital parameters.
- Develop critical thinking and reasoning and communicate ideas effectively, both in the mother tongue and in other languages.
- Develop independent learning strategies.
- Isolate, identify and analyse material of biological origin.
- Obtain information, design experiments and interpret biological results.
- Understand the processes that determine the functioning of living beings in each of their levels of organisation.

Learning Outcomes

1. Apply statistical and computer resources to the interpretation of data.
2. Be able to analyse and synthesise.
3. Be able to organise and plan.
4. Calculate and interpret the kinetic and thermodynamic parameters that define enzyme reactions.
5. Correctly describe the principal metabolic pathways and their mechanisms of control and integration.
6. Correctly use the terminology of biochemistry and its text and reference books.
7. Describe on the molecular scale the mechanisms that operate in the cell: the replication of genetic material, its expression in the form of proteins and, finally, metabolism.
8. Describe the components of the electronic transport chain, its coupling with oxidative phosphorylation and the generation of metabolic energy.
9. Describe the metabolism of glucids, lipids, amino acids and nucleotides.
10. Develop critical thinking and reasoning and communicate ideas effectively, both in the mother tongue and in other languages.
11. Develop independent learning strategies.
12. Identify the most suitable experimental approaches to study the structure and function of biomolecules.

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 CO_{22} and photosynthetic biosynthesis of sugars (Calvin cycle). Regulation of photosynthesis. Photorespiration and C_4 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.

Methodology

Training activities are distributed into three sections: theoretical classes, problem-solving classes and laboratory practical classes, each one with specific methodology. These activities will be complemented by mentoring sessions which may be planned additionally.

Theoretical classes

Teacher will explain the contents of the subject matter with audiovisual support which will be available for students at the "Campus Virtual" from the subject. The language of the support material will be Catalan, Spanish or English. These sessions will be the most important part of the theoretical section.

Problem-solving classes

During the course, 10 hours will be devoted to problem-solving classes.

Students will be divided into 2 subgroups (with a maximum of 30 students each), and lists with composition of groups will be made available at the course starting. Students should attend to the classes planned for his/her subgroup.

The dossier with statements of problems to be solved will be uploaded to "Campus Virtual". In part of these sections, distributed along the semester, teacher will solve some problems, choosing the most representative ones. Additionally, in case of need, the teacher could use part of these sessions to theoretical subjects needed for solving some concrete problems. In other sessions, students will solve the problems with the help of the teacher. In addition, students can bring problem solved to class and the solution will be discussed jointly.

Laboratory practice

Students will be divided into 5 subgroups and groups composition will be announced in advance. In order to ensure proper development of practical sessions, only changes clearly justified and previously agreed with laboratory teachers will be accepted. In addition, exchanges are needed, i.e. changes moving a student towards another group should be accompanied by the corresponding change from a student of the other group. The use of lab coat, chemical safety googles, the practice protocols printed and read (they will be made available through "Campus Virtual"), and a notebook to write down data obtained at class.

At the established days, students will be called to the Biochemistry laboratory to perform basic experiments for biomolecules properties determination and analysis. The practical sessions and their evaluation will be carried out in groups of 2 persons. After each session, a questionnaire may be delivered with results and answers to the proposed questions.

Delivering written assignments through Virtual Campus

Delivery will be done through the "Campus Virtual" corresponding tool and will consist of questions that should be answered in the indicated deadline. Questions will be related with concepts explained in theoretical classes as well as with self-learning themes that should be searched independently by students. There will be 2 different deliveries along the semester.

Mentoring sessions

These sessions will be individual and planned according to students' requests. In case of a high number of requests, a joint general mentoring class could be planned, which would be announced through "Campus Virtual" in advance. The objective of these sessions is to solve queries, refresh basic concepts and sources for consulting, and foster discussions about self-learning issues, or issues proposed by teachers. These sessions will not be expository and will not 'advance' in official subjects, being rather for discussion.

Activities

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Laboratory practice	8	0.32	1, 4, 2
Problem-solving classes	10	0.4	1, 4, 10
Theoretical classes	32	1.28	7, 5, 9, 8
Type: Supervised			
Delivery of written assignment through "Campus Virtual"	4	0.16	11, 2, 6
Mentoring sessions	6	0.24	10, 2
Type: Autonomous			
Individual study	60	2.4	11, 2
Self-learning exercises	12	0.48	11, 2, 3

Assessment

This subject will have continuous work performance evaluation. The objective of the continuous evaluation is to foster students' efforts along the different topics, as well as monitoring their understanding.

Theoretical evaluation:

Individual evaluation consisting of:

- Two partial exams with multiple choice questions. The weight of each partial exam is 30% of the overall global score. There are no requirements for attendance.

- One retake exam with multiple choice questions corresponding to the first or second partial exams. To be eventually eligible for the application of the retake process for final grading, the student should have been

evaluated in a set of activities equaling at least two thirds of the final score of the course or module. Thus, the student will be graded as "No Avaluable" (Not Assessable) if the weighting of all conducted evaluation activities, before application of the retake evaluation derived grades, is less than 67% of the final score.

Students obtaining a grade below 4.0 out of 10.0 of one or both partial exams should attend to the retake exam (for the first, second or both partials).

It is possible to improve grades obtained in partial theoretical exams standing for the retake exam. However, the final score will be the one obtained in the retake exam, regardless it is better, equal or worst to the partial exam.

- Delivery of written assignments through "Campus Virtual". This delivery will be individual and each one will have a weight of 5%.

The overall weight of theoretical evaluation will be 70%.

Problem-solving evaluation:

Individual evaluation consisting of:

- Two partial exams with problems to be solved corresponding to different subject topics. The weight of each partial exam is 10% of the overall global score.

- One retake exam with problems to be solved corresponding to first or second partials. To be eventually eligible for the application of the retake process for final grading, the student should have been evaluated in a set of activities equaling at least two thirds of the final score of the course or module. This exam is aimed to students that did not attend to or did not get a score above 4.0 out of 10.0 in one or both partials. It is possible to improve grades obtained in partial theoretical exams standing for the retake exam. However, the final score will be the one obtained in the retake exam, regardless it is better, equal or worst to the partial exam.

The overall weight of problem-solving evaluation will be 20%.

Laboratory practice evaluation:

Group evaluation consisting of:

- Presentation of the obtained results during laboratory work and answers for the proposed questions. Behaviour and conduct in the laboratory will be also taken into consideration.

Attending to the practical sessions is mandatory. Students will be graded as "No Avaluable" (Not Assessable) when absence is above 20% of the planned classes.

Only exceptional and properly justified group changes will be accepted and documentary proof should be provided. In case of justified non-attendance to a practical session and impossibility to attend to a different group, this session will not be taken into account for calculating the final score.

The overall weight of laboratory practice evaluation will be 10%.

Calculating scores

The three sections are indivisible and students should participate and be evaluated in all of them to pass the subject. The final score is calculating taking into account weights previously mentioned (70% theory, 20% problem-solving and 10% laboratory practice). The student is approved when the final score is above 50 out of 100.

Other remarks:

Students unable to attend an evaluation due to justified reasons (illness, death of a familiar member, accident) and deliver valid proof of such condition to the teacher/degree Coordinator, will be allowed to perform the missing evaluation at a different date.

Students will be graded as "No Avaluable" (Not Assessable) if the weighting of all conducted evaluation activities is less than 67% of the final score.

Repeating students will be exempt to repeat teaching and evaluation activities already approved from the second enrollment on (e.g. solving problems, laboratory practice, delivery of assignments through Campus Virtual).

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Laboratory work evaluation	10	8	0.32	1, 4, 11, 10, 12, 2, 3
Problem-solving exams	20	3	0.12	4, 7, 5, 9, 8
Theoretical exams	70	7	0.28	7, 5, 9, 8, 6

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