Universitat Autònoma de Barcelona

2021/2022

Metabolism of Biomolecules

Code: 101915
ECTS Credits: 6

Degree	Type	Year	Semester
2501230 Biomedical Sciences	FB	1	2

The proposed teaching and assessment methodology that appear in the guide may be subject to changes as a result of the restrictions to face-to-face class attendance imposed by the health authorities.

Contact

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Use of Languages

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

Other comments on languages

Students will be asked to volunteer to an English group of "Seminaris d'autoaprenentatge Tutoritzat"

Teachers

José Miguel Lizcano de Vega
Carles Gil Giró
Jordi Ortiz de Pablo
Enrique Claro Izaguirre
Francisco Blanco Vaca
Jose Ramon Bayascas Ramirez

Prerequisites

Although there are no official prerequisites, it is highly recommended to have passed Structure and function of Biomolecules and Organic Chemistry.

It is convenient to review the following subjects of the baccalaureate program:
- Chemical reactions of oxidation-reduction and nucleophilic substitutions
- Cell metabolism: Glicolysis, Krebs cycle and ATP synthesis

Objectives and Contextualisation

In the context of Basic Biochemistry, the Metabolism of Biomolecules subject focuses on knowledge of sources, forms of storage and use of energy and nutrients for human body cells. The catabolic and anabolic pathways of carbohydrates, lipids, amino acids and nucleotides, and their hormonal regulation, are studied. Emphasis is placed on the mechanisms of metabolic regulation, differentiating states of good nutrition and fasting, and on the discussion of biochemical changes present in common metabolic pathologies.

The aim is for the student to achieve a global understanding of human metabolism that integrates their main mechanisms, functions and regulation. This understanding will be used as a basis to be able to deepen in specific subjects during the rest of the degree studies with the help of textbooks, in particular in subjects such as Molecular Biology of the Cell, Systems Physiology, Pharmacology, Clinical Biochemistry and Biological Bases of Pathology. Critical reading of the bibliography and tutored discussions should be used to describe molecular processes that cause pathologies using a correct biochemical terminology.

Competences

- Act with ethical responsibility and respect for fundamental rights and duties, diversity and democratic values.
- Describe biomedical problems in terms of causes, mechanisms and treatments.
- Display knowledge of the basic life processes on several levels of organisation: molecular, cellular, tissues, organs, individual and populations.
- Display knowledge of the concepts and language of biomedical sciences in order to follow biomedical literature correctly.
- Display theoretical and practical knowledge of the major molecular and cellular bases of human and animal pathologies.
- Make changes to methods and processes in the area of knowledge in order to provide innovative responses to society's needs and demands.
- Read and critically analyse original and review papers on biomedical issues and assess and choose the appropriate methodological descriptions for biomedical laboratory research work.
- Students must be capable of applying their knowledge to their work or vocation in a professional way and they should have building arguments and problem resolution skills within their area of study.
- Students must be capable of collecting and interpreting relevant data (usually within their area of study) in order to make statements that reflect social, scientific or ethical relevant issues.
- Students must be capable of communicating information, ideas, problems and solutions to both specialised and non-specialised audiences.
- Students must develop the necessary learning skills to undertake further training with a high degree of autonomy.
- Students must have and understand knowledge of an area of study built on the basis of general secondary education, and while it relies on some advanced textbooks it also includes some aspects coming from the forefront of its field of study.
- Take account of social, economic and environmental impacts when operating within one's own area of knowledge.
- Work as part of a group with members of other professions, understanding their viewpoint and establishing a constructive collaboration.

Learning Outcomes

1. Act with ethical responsibility and respect for fundamental rights and duties, diversity and democratic values.
2. Correctly describe the principal metabolic pathways and their mechanisms of control and integration.
3. Correctly use the terminology of biochemistry and its text and reference books.
4. Define alterations of the cell redox balance and oxidative stress caused by free radicals.
5. Describe correctly the structural and thermodynamic bases of cell bioenergetics and transport across membranes.
6. Describe the basic structural and functional characteristics of amino acids, proteins, glucids, lipids and biological membranes, nucleotides and nucleic acids.
7. Describe the components of the electronic transport chain, its coupling with oxidative phosphorylation and the generation of metabolic energy.
8. Explain the principal molecular mechanisms responsible for signal transduction.
9. Identify molecular processes that could be a cause or a consequence of pathological processes.
10. Identify the principal alterations of the metabolism of glucids, lipids, amino acids and nucleotides, and their pathological implications.
11. Identify the principles that govern electron transfer and its role in metabolism.

12. Infer physiological and clinical correlations from the intermediate metabolism in cases of fasting, muscular fatigue diabetes and cancer.
13. Interpret the parameters that define the binding of ligands to macromolecules.
14. Make changes to methods and processes in the area of knowledge in order to provide innovative responses to society's needs and demands.
15. Students must be capable of applying their knowledge to their work or vocation in a professional way and they should have building arguments and problem resolution skills within their area of study.
16. Students must be capable of collecting and interpreting relevant data (usually within their area of study) in order to make statements that reflect social, scientific or ethical relevant issues.
17. Students must be capable of communicating information, ideas, problems and solutions to both specialised and non-specialised audiences.
18. Students must develop the necessary learning skills to undertake further training with a high degree of autonomy.
19. Students must have and understand knowledge of an area of study built on the basis of general secondary education, and while it relies on some advanced textbooks it also includes some aspects coming from the forefront of its field of study.
20. Take account of social, economic and environmental impacts when operating within one's own area of knowledge.
21. Understand and critique scientific articles on biochemistry.
22. Understand cell metabolism and gene expression by relating the activity of the different cell compartments to their control by the action of hormones, neurotransmitters and growth factors.
23. Work as part of a group with members of other professions, understanding their viewpoint and establishing a constructive collaboration.

Content

Topic 1. Introduction to metabolism.
Bioenergetics. Molecular mechanisms of intercellular communication. Interaction between hormones and receptors. Main intracellular signaling pathways. Control of energy metabolism.

Topic 2. Common phase of oxidative metabolism.
Mitochondrial energy metabolism. Cycle of tricarboxylic acids. Electron transfers. ATP synthesis. Free radicals

Topic 3. Structure and metabolism of carbohydrates.
Characteristics, origin and function of carbohydrates. Digestion and absorption of carbohydrates. Glycolysis. Gluconeogenesis. Glycogen metabolism. Pentose phosphate pathway. Common alterations in the regulation of carbohydrate metabolism.

Topic 4. Structure and metabolism of lipids.
Energy reserve. Obtaining energy from fatty acids. Synthesis of fatty acids and triacylglycerides. Metabolism of lipids with structural function. Cholesterol metabolism. Transport of lipids in blood by lipoproteins. Common alterations in the regulation of lipid metabolism.

Topic 5. Metabolism of nitrogen compounds.
Metabolism of amino acids. Urea cycle. Metabolism of nucleotides. Derivatives of amino acids and nucleotides.

Topic 6. Integration and control of metabolism.
Metabolic particularities of some tissues. Interrelationships between tissues during the feed-fast cycle and in various nutritional or hormonal states. Physical exercise. Obesity. Diabetes

Unless the requirements enforced by the health authorities demand a prioritization or reduction of these contents

Methodology

The teaching methodology will consist of theory classes, of tutored self-study seminars where practical and clinical cases will be discussed, and of laboratory practices. The main teaching material for these activities will be provided through the UAB virtual campus.

The theoretical classes will be taught in the form of lectures to the entire group. The teachers will also comment on the material available for the other activities, including materials for self-learning.

When finishing each subject, the students will be tutored in smaller groups to discuss cases of practical or clinical application. This activity will be called "Tutored Self-Study Seminars" as students will have a script with questions that will have to be solved, prior to the class or in the same class, where they will discuss them with their peers with the tutor acting as moderator,

The laboratory practices will consist of a script and a list of questions that students will have to solve during the practice. In order to be able to attend the practical sessions, the student must justify having passed the biosafety and security tests that he will find in the Virtual Campus and be familiar with and accept the rules of operation of the Faculty's laboratories.

Additionally students will be able to have specific tutor sessions.

The proposed teaching methodology may experience some modifications depending on the restrictions to face-to-face activities enforced by health authorities

Annotation: Within the schedule set by the centre or degree programme, 15 minutes of one class will be reserved for students to evaluate their lecturers and their courses or modules through questionnaires.

Activities

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
"Tutored Self-Study Seminars" on practical or clinical cases	17	0.68	22, 21, 4, 5, 2, 7, 6, 8, 11, 10, 9, 12, 13, 23, 3
Laboratory practices	6	0.24	2, 12, 23
Lectures (theory classes)	27	1.08	22, 4, 5, 2, 7, 6, 8, 11, 10, 12
Type: Supervised			
Preparation of practical or clinical cases	17	0.68	22, 21, 4, 5, 2, 7, 6, 8, 11, 10, 9, 12, 13, 23, 3
Type: Autonomous			
Personal study	71	2.84	22, 21, 4, 5, 2, 7, 6, 8, 11, 10, 9, 12, 13, 23, 3

Assessment

There will be 2 partial test. First test will have a value of 47,5% of the total grade. It will include topics 1, 2 and 3, as well as first laboratory demonstration. Second test will have a value of 47,5% of the total grade. It will include topics 4, 5 and 6, as well as second laboratory demonstration.

Attendance to laboratory practices is mandatory. Students will obtain the "Non-Assessed" qualification if the absence to practices exceeds 20% of the scheduled hours. During the practical sessions, students will be assessed whether they work in groups (T01), respect for norms (T05), and self-learn (T04, G02). The evaluation of competences during the practical sessions will have a value of 5% of the total grade. Additionally, the content of the practices related to the theoretical subject will be evaluated in the continuous, global and final evaluation exercises.

Final Test will consist of a global exam containing all the topics covered. Final test will have a value of 95%.

To pass the topic, final marks must be equal or superior to 5 (over ten). Also, it will be essential to obtain at least 4 out of 10 points in the overall exam.

There will be an overall exam for those students who failed previous test. The grade obtained in this exam will be 100% of total grade. This exam will include contents of the entire syllabus and will be in written form, although the teachers can complete the assessment with oral questions.

The students will obtain the "Non-Assessed" qualification when the evaluation activities carried out have a weigh of less than 67% of the total grade.

The assessments will be done mainly by means of written exams to reflect the achievement of learning results, with a limited space to answer. Written answers that demonstrate a lack of required knowledge may justify a decrease of the grade. In addition, there may be multi-answer tests, oral and expositive activities, and the student's active participation in the activities of the subject can be evaluated.

Student's assessment may experience some modifications depending on the restrictions to face-to-face activities enforced by health authorities.

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Continous assessment	45% total grade	3	0.12	22, 21, 4, 5, 2, 7, 6, 8, 11, 10, 9, 12, 13, 19, 17, 15, 16, 23, 3
Laboratory practices	5%	6	0.24	1, 20, 22, 2, 10, 9, 12, 14, 23, 3
Overall exam	50% total grade	3	0.12	22, 21, 4, 5, 2, 7, 6, 8, 11, 10, 9, 12, 13, 19, 18, 17, 15, 16, 3

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Software

No specific software will be used