Universitat Autònoma de Barcelona

2023/2024

Metabolic Biochemistry

Code: 103597
ECTS Credits: 7

Degree	Type	Year	Semester
2502442 Medicine	FB	1	2

Contact

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Teaching groups languages

You can check it through this link. To consult the language you will need to enter the CODE of the subject.
Please note that this information is provisional until 30 November 2023.

Teachers

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Prerequisites

Although there are no official prerequisites, it is highly recommended to have passed the subject "Structural Biochemistry and Molecular Biology."

In any case, it is worthy to review the following high school subjects:

- Organic chemical functions and their reactions
- Chemical reactions of oxidation-reduction and nucleophilic substitutions
- General concepts of metabolism

Objectives and Contextualisation

The Metabolic Biochemistry subject focuses on the knowledge of the sources, forms of storage and use of energy and nutrients in the human organism, distinguishing the different metabolic specializations.

The main catabolic and anabolic pathways and their regulation are studied. Emphasis is placed on the interrelations of the metabolism of carbohydrates, lipids, amino acids and nucleotides, in the mechanisms of hormonal regulation during the fast-feed cycle; the biochemical alterations present in common metabolic pathologies are also discussed.

The student is expected to achieve a global understanding of human metabolism that will integrate their principal mechanisms, functions and regulation. This understanding will serve, with the help of textbooks, as the basis for further specific topics during the rest of the degree studies, particularly in subjects such as Physiology, Pharmacology or Clinical Biochemistry.

Competences

- Communicate clearly, orally and in writing, with other professionals and the media.
- Critically assess and use clinical and biomedical information sources to obtain, organise, interpret and present information on science and health.
- Demonstrate basic research skills.
- Demonstrate knowledge of the principles and physical, biochemical and biological processes that help to understand the functioning of the organism and its disorders.
- Demonstrate understanding of the basic sciences and the principles underpinning them.
- Demonstrate understanding of the importance and the limitations of scientific thought to the study, prevention and management of diseases.
- Demonstrate understanding of the mechanisms of alterations to the structure and function of the systems of the organism in illness.
- Demonstrate understanding of the organisation and functions of the genome, the mechanisms of transmission and expression of genetic information and the molecular and cellular bases of genetic analysis.
- Demonstrate understanding of the structure and function of the body systems of the normal human organism at different stages in life and in both sexes.
- Demonstrate, in professional activity, a perspective that is critical, creative and research-oriented.
- Formulate hypotheses and compile and critically assess information for problem-solving, using the scientific method.
- Maintain and sharpen one's professional competence, in particular by independently learning new material and techniques and by focusing on quality.
- Use information and communication technologies in professional practice.

Learning Outcomes

1. Communicate clearly, orally and in writing, with other professionals and the media.
2. Demonstrate basic research skills.
3. Demonstrate, in professional activity, a perspective that is critical, creative and research-oriented.
4. Describe the basic molecular mechanisms of storage, transmission and expression of hereditary information.
5. Describe the mechanisms, regulation and functions of the main metabolic pathways of the human organism.
6. Describe the molecular basis of the structure of the biological macromolecules and of how this structure conditions their activity.
7. Describe the role of of the biomolecules that participate in the life processes of the human organism.
8. Explain the mechanisms and relate the molecular processes that can be the cause or the consequence of pathological manifestations in the organism.
9. Explain the molecular significance of the structure and function of the systems of the human organism.
10. Formulate hypotheses and compile and critically assess information for problem-solving, using the scientific method.

11. Identify the basic processes of life on various levels of organisation: molecule, cell, tissue, organ, and individual.
12. Identify the biochemical tools that help to improve medicine.
13. Identify the chemical bases that help to understand the functioning of the organism, at both cell and tissue level.
14. Identify the mechanisms of enzymatic transformation of biomolecules.
15. Identify the rules that govern energy transfer in the chemical processes of the human organism.
16. Maintain and sharpen one's professional competence, in particular by independently learning new material and techniques and by focusing on quality.
17. Make correct use of biochemistry terminology.
18. Relate alterations to the structure and function of biomolecules to structural and functional alterations to systems of the human organism.
19. Relate the molecular and cellular processes that can be the cause or the consequence pathological manifestations in the organism.
20. Relate the molecular mechanisms that can generate pathological manifestations in the organism.
21. Use information and communication technologies in professional practice.
22. Use specific bibliographic sources and databases on biochemistry to work independently on acquiring further knowledge.

Content

THEMATIC BLOCKS OF THEORY AND SEMINARS:

Unit 1. Introduction to metabolism and its regulation. Biochemistry of cell signalling

Basic concepts of Bioenergetics. Control of energy metabolism. Main routes of inter and intracellular signalling controlling energetic metabolism (5 hours of lectures and 2 hours of specialized seminars).

Unit 2. Common phase of oxidative metabolism

Mitochondrial energy metabolism: pyruvate deshidrogenase, cycle of tricarboxylic acids and oxidative phosphorylation. Oxygen free radicals (4 hours of lectures and 4 hours of specialized seminars).

Unit 3. Structure and metabolism of carbohydrates

Structure, characteristics, origin and function of carbohydrates. Digestion and absorption of carbohydrates. Glycolysis Gluconeogenesis. Glycogen metabolism. Route of the pentoses phosphate. Common alterations in the regulation of carbohydrate metabolism (6 hours of lectures and 4 hours of specialized seminars).

Unit 4. Structure and metabolism of lipids

Structure and characteristics of lipids. 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. (6 hours of lectures and 4 hours of specialized seminars). At the end of the subject, there will be 1 session of a classroom practice about dyslipidemia (2 hours)

Unit 5. Metabolism of nitrogenized compounds

Metabolism of amino acids. Cycle of urea. Metabolism of amino acid derivatives: non-nucleotide and nucleotide nitrogen derivatives (4 hours of lectures and 2 hours of specialized seminars).

Unit 6. Integration and control of metabolism

Metabolic particularities of some tissues.Interrelations between the tissues during the feeding-fast cycle and under particular physiological and pathological states (2 hours of lectures and 4 hours of specialized seminars).

LABORATORY PRACTICES:

- Control of carbohydrates metabolism: determination of pyruvate kinase activity and glycemia (1 session, 4 hours)
- Determination of serum lipids: total cholesterol and HDL cholesterol (1 session, 4 hours)
- Determination of liver transaminase ALT and AST activities (1 session, 4 hours)

Methodology

The teaching methodology will consist of theory classes (TE), specialized seminars (SEM) where practical and clinical cases will be discussed, laboratory practices (PLAB) and a classroom practice (PAUL), all of them supervised. The main teaching material for these activities will be provided through the UAB Moodle platform.

The theory classes (27 hours) will be given in the form of one hour lectures in which the teachers will also comment on the material available for other activities, including materials for self-learning.

Students will attend specialized seminars in small groups. They will work in small groups for the discussion of course materials, clinical case studies or problem solving (10 sessions of 2 hours). A tutor will act as moderator.

For the laboratory practices (3 sessions of 4 hours) a laboratory handbook will be followed. Students will find a questionnaire to be solved.

The classroom practice on dyslipidemia (1 session of 2 hours) will be given by the Head of the Clinical Biochemistry Service of the Hospital de la Santa Cruz and Sant Pau.

Finally, following the self-study of the students and previously asking for an appointment with the professors, the students will be able to have specific tutorials.

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			
CLASSROOM PRACTICES (PAUL)	2	0.08	7, 5, 6, 9, 8, 11, 13, 12, 20, 19, 18, 17
LABORATORY PRACTICES (PLAB)	12	0.48	2, 5, 8, 10, 14, 13, 12, 16, 20, 19, 17, 21
SEMINARS (SEM)	20	0.8	1, 2, 3, 7, 5, 6, 9, 8, 10, 14, 11, 13, 12, 15, 16, 20, 19, 18, 17, 22, 21
THEORY (TE)	27	1.08	2, 3, 7, 5, 6, 9, 8, 10, 14, 11, 13, 12, 15, 20, 19, 18, 17, 21
Type: Supervised			
ACTIVITIES AVAILABLE AT THE MOODLE PLATFORM, PREPARATION OF SEM ACTIVITIES, TUTORIALS	17.5	0.7	1, 2, 3, 7, 5, 6, 9, 8, 10, 14, 11, 13, 12, 15, 16, 20, 19, 18, 17,

			22, 21
Type: Autonomous			
SELF STUDY / PREPARATION OF WRITTEN WORKS	88	3.52	3, 7, 5, 6, 9, 8, 10, 14, 11, 13, 12, 15, 16, 20, 19, 18, 17, 22, 21

Assessment

CONTINUOUS EVALUATION

The average mark of the subject is calculated based on the grades obtained in 4 assessment activities:

- Exam 1, which evaluates Units 1-3, SEM 1-5, and PLAB 1. Consists in a written exam with objective tests of multiple-choice items and/or test of essay, with a total weight of 45% of the final mark.
- Exam 2, which evaluates Units 4-6, SEM 6-10, PLAB 2 and 3, and PAUL. Consists in a written exam with objective tests of multiple-choice items and/or test of essay, with a total weight of 45% of the final mark.
- Laboratory practices (PLAB) and classroom practices (PAUL) attendance, with a total weight of 5% of the final mark. This note is all or nothing. If the students attend to the three laboratory practices and the classroom practice they will obtain the maximum score, but no points will be given with a lower attendance.
- Special seminar (SEM) attendance, with a total weight of 5% of the final mark. This note is all or nothing. If students attend, at least, to 80% of the seminars they will obtain the maximum score, but no points will be awarded with a lower attendance.

FORMAT OF EXAMS

In all cases, the examinations will be assessments written through objective tests of two types of assessment - multiple choice items and/or essay tests - aimed at reflecting the achievement of competences and the recognition of concepts.

REQUIREMENTS TO PASS THE SUBJECT

To pass the subject, the marks of exam 1 (or its recuperation) and exam 2 (or its recuperation) must be, in both cases, equal or superior than 4 out of 10 and the final mark, result of all the continuous evaluation activities (see formula) must be equal to or higher than 5 out of 10.

TEST OF RECOVERY

Students who have not obtained a grade equal to or greater than 4 in exam 1 or exam 2 can recover the part or parts not approved in the final recovery exam.This test will consist of an exam with objective tests of multiple-choice items and/or essay tests of the failed part or parts.

Students who have not obtained a grade equal to or higher than 4 in the two partial exams can take the global exam to obtain a single grade that will represent 100% of the final grade. In this case, the marks obtained in the continuous assessment will no longer be taken into account.

The final mark will be calculated with the following formula:

Final grade with partial exams = exam 1 grade (or its recovery) x 0.45 + exam 2 grade (or its recovery) x 0.45 + 0.5 points for attendance at all practices + 0.5 points for attendance at 80% of the SEMs. It is necessary to obtain a grade of 4 or higher in each partial exam in order to pass. If one of the grades in the partial exams is lower than 4, the average will not be taken and this grade will be the final record.

Final grade with global exam = exam grade.

All students have the option of evaluating the entire subject in the final recovery exam, renouncing all the marks previously obtained in continuous evaluation. In this case, the test will cover the entire subject (including

laboratory practices, classroom practices, and seminars), will have a weight of 100% of the grade, and will be the final grade. It is understood that the students who, having passed the subject, decide to present themselves to this test, renounce the mark obtained and will obtain the grade of this proof of recovery as grade of the subject.

Students who do not take 67% of the continuous assessment activities (that is, who do not take exam 1 or exam 2) and do not submit to the recovery exam will be considered Non-evaluable.

UNIQUE EVALUATION

In this case, there is a single final exam that will include the entire subject (including the teaching materials of laboratory practices, classroom practice and seminars), will have a weight of 100% of the grade and will be the final grade The exam format will be identical to the continuous evaluation. Students who did not get a grade equal to or higher than 5 in the final exam can take the recovery exam, and the grade obtained will have a weight of 100% of the grade and will be the final grade. Students who do not appear for the final exam and their recovery will be graded as non-evaluable. The review of the final qualification follows the same procedure as for the continuous evaluation.

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
1st examination: Written assessments through objective tests: multiple-choice items and/or essay tests	45 % of the final mark	3.5	0.14	1, 2, 3, 7, 4, 5, 6, 9, 8, 10, 14, 11, 13, 12, 15, 16, 20, 19, 18, 17, 22, 21
2nd examination: Written assessments through objective tests: multiple choice items and/or essay tests	45% of the final mark	3.5	0.14	1, 2, 3, 7, 4, 5, 6, 9, 8, 10, 14, 11, 13, 12, 15, 16, 20, 19, 18, 17, 22, 21
Laboratory and classroom practices attendance	5% of the final mark	0.5	0.02	2, 3, 8, 10, 12, 16, 20, 19
Special seminar attendance	5% of the final mark	1	0.04	1, 2, 3, 7, 4, 5, 6, 9, 8, 10, 14, 11, 13, 12, 15, 16, 20, 19, 18, 17, 22, 21

Bibliography

We suggest you the following books. Marked with an asterisk (*) are the free e-books at the UAB libraries web sites:

Complete books:

- Nelson DL, Cox MM. Lehninger. Principios de Bioquímica, 7ª ed. Editorial Omega, 2018.
- Voet D, Voet JG, Pratt CH. Fundamentos de Bioquímica: La vida a nivel molecular. 4ª ed. Editorial Médica Panamericana, 2016. (*)

Medium complexity books:

- Stryer L, Berg JM, Tymoczko JL. Bioquímica. Curso básico, 1ª ed. Editorial Reverté, 2019. (*)
- Mathews CK, Van Holde KE, Appling DR, Spencer JA-C. Bioquímica, 4ª ed. Editorial Pearson, 2013.
- Lieberman MA, Peet A. Bioquímica médica básica: Un enfoque clínico. 5ª ed. Editorial Wolters Kluwer, 2018. (*)

Basic books:

- Denise R. Ferrier: Lippincott's Illustrated Reviews: Bioquímica, 7ª ed. Editorial Wolters Kluwer, 2018. (*)
- John W. Baynes, Marek H. Dominiczak: Bioquímica Médica, 4ª ed. Editorial Elsevier, 2015. (*)

Digital resources coreesponding to particular contents of the subject will be published at the Moodle platform through the semester.

Software

No specific software required.