

**Metabolic Biochemistry**

Code: 103597  
ECTS Credits: 7

Degree	Type	Year	Semester
2502442 Medicine	FB	1	2

**Contact**

Name: Jose Ramon Bayascas Ramirez  
Email: JoseRamon.Bayascas@uab.cat

**Use of Languages**

Principal working language: spanish (spa)  
Some groups entirely in English: No  
Some groups entirely in Catalan: No  
Some groups entirely in Spanish: No

**Other comments on languages**

English will be optional in one out of six laboratory groups

**Teachers**

José Aguilera Ávila  
José Miguel Lizcano de Vega  
Jordi Ortiz de Pablo  
Enrique Claro Izaguirre  
Francisco Blanco Vaca  
Jose Manuel Lopez Blanco  
Victor Jose Yuste Mateos  
Alberto Fernández de Arriba  
Laura Rubio Ferrarons  
Cristina Fabregas Ordoñez  
Nora Diéguez Martínez  
Sally Hamdon  
Anna del Ser Badia  
Maria Antonia Baltrons Soler  
Roser Masgrau Juanola  
Alfredo Jesús Miñano Molina

**External teachers**

Montse Solé Piñol  
Rebeca Blanch

## 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 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 mechanisms, regulation and functions of the main metabolic pathways of the human organism.
5. Describe the molecular basis of the structure of the biological macromolecules and of how this structure conditions their activity.
6. Describe the role of the biomolecules that participate in the life processes of the human organism.
7. Explain the mechanisms and relate the molecular processes that can be the cause or the consequence of pathological manifestations in the organism.
8. Explain the molecular significance of the structure and function of the systems of the human organism.
9. Formulate hypotheses and compile and critically assess information for problem-solving, using the scientific method.
10. Identify the basic processes of life on various levels of organisation: molecule, cell, tissue, organ, and individual.
11. Identify the biochemical tools that help to improve medicine.
12. Identify the chemical bases that help to understand the functioning of the organism, at both cell and tissue level.
13. Identify the mechanisms of enzymatic transformation of biomolecules.
14. Identify the rules that govern energy transfer in the chemical processes of the human organism.
15. Maintain and sharpen one's professional competence, in particular by independently learning new material and techniques and by focusing on quality.
16. Make correct use of biochemistry terminology.
17. Relate alterations to the structure and function of biomolecules to structural and functional alterations to systems of the human organism.
18. Relate the molecular and cellular processes that can be the cause or the consequence pathological manifestations in the organism.
19. Relate the molecular mechanisms that can generate pathological manifestations in the organism.
20. Use information and communication technologies in professional practice.
21. 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 (5 hours)

Basic concepts of Bioenergetics. Control of energy metabolism. Molecular mechanisms of intercellular communication. Main routes of intracellular signalling. At the end of the subject, there will be 2 sessions of specialized seminars (4 hours)

Unit 2. Common phase of oxidative metabolism (4 hours)

Mitochondrial energy metabolism. Cycle of tricarboxylic acids. Electron transfers. ATP synthesis. Free radicals. At the end of the subject, there will be 1 session of specialized seminars (2 hours)

Unit 3. Structure and metabolism of carbohydrates (6 hours)

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. At the end of the subject, there will be 2 sessions of specialized seminars (4 hours)

Unit 4. Structure and metabolism of lipids (6 hours)

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. At the end of the subject, there will be 2 sessions of specialized seminars (4 hours)

Unit 5. Metabolism of nitrogenized compounds (4 hours)

Metabolism of amino acids. Cycle of urea. Metabolism of amino acid derivatives: non-nucleotide and nucleotide nitrogen derivatives. At the end of the subject, there will be 1 session of specialized seminars (2 hours)

Unit 6. Integration and control of metabolism (2 hours)

Metabolic particularities of some tissues. Interrelations between the tissues during the feeding-fast cycle.

Interrelations between tissues in various nutritional or hormonal states. At the end of the subject, there will be 2 sessions of specialized seminars (4 hours)

#### LABORATORY PRACTICES

- Metabolic changes associated with fasting state: Effects on pyruvate kinase activity and the amount of glycogen in the liver (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)

#### CLASSROOM PRACTICE

- Dyslipidemia: presentation of a clinical case (1 session, 2 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 sessions in which the teachers will also comment on the material available for other activities, including materials for self-learning. When finishing each subject, the students will attend specialized seminars in small groups to comment on doubts and discuss cases of practical or clinical application. In this activity (10 sessions of 2 hours), the students will be proposed with some questions or cases that will have to be solved in groups and then discussed with their classmates and the tutor, who will act as moderator.

For the laboratory practices (3 sessions of 4 hours) a laboratory handbook will be followed in which the students will find a questionnaire to be solved in the same laboratory and delivered to the teacher. 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.

### Activities

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
CLASSROOM PRACTICES (PAUL)	2	0.08	6, 4, 5, 8, 7, 10, 12, 11, 19, 18, 17, 16
LABORATORY PRACTICES (PLAB)	12	0.48	2, 4, 7, 9, 13, 12, 11, 15, 19, 18, 16, 20
SEMINARS (SEM)	20	0.8	1, 2, 3, 6, 4, 5, 8, 7, 9, 13, 10, 12, 11, 14, 15, 19, 18, 17, 16, 21, 20

THEORY (TE)	27	1.08	2, 3, 6, 4, 5, 8, 7, 9, 13, 10, 12, 11, 14, 19, 18, 17, 16, 20
Type: Supervised			
ORAL PRESENTATION / EXPOSITION OF WRITTEN WORKS	17.5	0.7	1, 2, 3, 6, 4, 5, 8, 7, 9, 13, 10, 12, 11, 14, 15, 19, 18, 17, 16, 21, 20
Type: Autonomous			
SELF STUDY / PREPARATION OF WRITTEN WORKS	88	3.52	3, 6, 4, 5, 8, 7, 9, 13, 10, 12, 11, 14, 15, 19, 18, 17, 16, 21, 20

## Assessment

The average mark of the subject is calculated based on the grades obtained in 7 assessment activities:

- 5 short examinations of continuous evaluation that will be done in schedule of SESP, with a total weight of 50% of the final mark (10% each)
- 1 final exam of a global nature, with a total weight of 45% of the final mark
- Laboratory and classroom practice attendance and progress, with a total weight of 5% of the final mark

### FORMAT OF EXAMS

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

The 5 continuous assessment exams, which will be carried out during the course in the SESP schedule, will consist of a test essay of restricted questions and/or several items of multiple selection.

The final global exam will consist of 5 test essays for restricted questions and 30 items for multiple selection.

### REQUIREMENTS TO PASS THE SUBJECT

To pass the subject, the final mark must be equal to or higher than 5 out of 10.

### TEST OF RECOVERY

A few days after the revision of the final exam, a global recovery test will be carried out, in the same format as the final exam, which will aim to re-evaluate the students that have failed the subject. The mark of this exam will be the final grade. It is understood that the students who, having passed the subject by course, decide to present themselves to this test, renounce the mark obtained by course and will obtain the grade of this proof of recovery as grade of the subject.

Students who do not take an evaluation test or who have not passed through the continuous assessment and the final exam, and do not submit to the recovery exam, will be considered Not-assessable.

## Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
1st short examination of continuous evaluation: Written assessments through objective tests: selection items / essay tests	10% of the final mark	0.5	0.02	1, 2, 3, 6, 4, 5, 8, 7, 9, 13, 10, 12, 11, 14, 15, 19, 18, 17, 16, 21, 20

2nd short examination of continuous evaluation: Written assessments through objective tests: selection items / essay tests	10% of the final mark	0.5	0.02	1, 2, 3, 6, 4, 5, 8, 7, 9, 13, 10, 12, 11, 14, 15, 19, 18, 17, 16, 21, 20
3rd short examination of continuous evaluation: Written assessments through objective tests: selection items / essay tests	10% of the final mark	0.5	0.02	1, 2, 3, 6, 4, 5, 8, 7, 9, 13, 10, 12, 11, 14, 15, 19, 18, 17, 16, 21, 20
4th short examination of continuous evaluation: Written assessments through objective tests: selection items / essay tests	10% of the final mark	0.5	0.02	1, 2, 3, 6, 4, 5, 8, 7, 9, 13, 10, 12, 11, 14, 15, 19, 18, 17, 16, 21, 20
5th short examination of continuous evaluation: Written assessments through objective tests: selection items / essay tests	10% of the final mark	0.5	0.02	1, 2, 3, 6, 4, 5, 8, 7, 9, 13, 10, 12, 11, 14, 15, 19, 18, 17, 16, 21, 20
Final exam : written avaluations by objective tests: ítems of selection/ assay test	45% of the final mark	5.5	0.22	1, 2, 3, 6, 4, 5, 8, 7, 9, 13, 10, 12, 11, 14, 15, 19, 18, 17, 16, 21, 20
Laboratory and classroom practices attendance	5% of the final mark	0.5	0.02	2, 3, 7, 9, 11, 15, 19, 18

## Bibliography

1. It is recommended to work assiduously with one of these two books :

- Denise S. Ferrier: Lippincott's Illustrated Reviews: Bioquímica, 6<sup>a</sup> ed. Editorial Wolters Kluwer, 2014.
- John W. Baynes, Marek H. Dominiczak: Bioquímica Médica, 4<sup>a</sup> ed. Editorial Elsevier, 2015.

2. Other reference Books:

- D.L. Nelson, M.M. Cox: Lehninger. Principios de Bioquímica, 6<sup>a</sup> ed. Editorial Omega, 2014.
- Lubert Stryer, Jeremy Berg, John Tymoczko: Bioquímica, 7<sup>a</sup> ed. Editorial Reverté, 2013.