Biochemistry

Code: 102522
ECTS Credits: 6

2025/2026

Degree	Type	Year
Chemistry	OB	3

Contact

Name: Arnau Cordomi Montoya

Email: arnau.cordomi@uab.cat

Teachers

Ana Paula Candiota Silveira

Arnau Cordomi Montoya

Teaching groups languages

You can view this information at the end of this document.

Prerequisites

There are no official prerequisites. However, it is assumed that the student has acquired the knowledge given in the first year subject of Fundamentals of Molecular and Cell Biology, especially those referring to enzymology and the structure and function of glucides, lipids, proteins and nucleic acids .

Objectives and Contextualisation

Context and objectives

The subject Biochemistry continues and complements a part of the contents given in the subject "Fundamentals of Molecular and Cell Biology". In the Biochemistry subject, the basic aspects of the metabolic pathways, the associated energy changes, their physiological significance, their interconnections and their response to biological signals are studied from a basic and general point of view.

The general objective of the subject is to provide an overview of the metabolism in living beings, as well as their regulation

Specific objectives of the subject are:

- To describe the general mechanisms through which living organisms obtain and transform the energy of the environment.

- To know the main molecular mechanisms for the transduction of biological signals.

- To describe the central pathways of the metabolism of glucides, lipids, amino acids and nucleotides.

- To know the components of the electronic transport chains, oxidative phosphorylation or photophosphorylation, and obtention of metabolic energy.

- To give an overview of the interconnections between the metabolic pathways, as well as the mechanisms that regulate them in a coordinated way and the changes in various physiopathological situations.

- To know how to apply the knowledge studied to solve qualitative and quantitative problems.

Competences

- Adapt to new situations.
- Communicate orally and in writing in one's own language.
- Evaluate the health risks and environmental and socioeconomic impact associated to chemical substances and the chemistry industry.
- Handle chemical products safely.
- Handle standard instruments and material in analytic and synthetic chemical laboratories.
- Learn autonomously.
- Manage, analyse and synthesise information.
- Manage the organisation and planning of tasks.
- Obtain information, including by digital means.
- Propose creative ideas and solutions.
- Reason in a critical manner
- Recognise and analyse chemical problems and propose suitable answers or studies to resolve them.
- Resolve problems and make decisions.
- Show an understanding of the basic concepts, principles, theories and facts of the different areas of chemistry.
- Show initiative and an enterprising spirit.
- Show sensitivity for environmental issues.
- Use IT to treat and present information.
- Work in a team and show concern for interpersonal relations at work.

Learning Outcomes

1. Adapt to new situations.
2. Apply the basic methods of recombinant DNA technology.
3. Communicate orally and in writing in one's own language.
4. Describe the basic methodologies of recombinant DNA technology for application to the expression of recombinant proteins.
5. Describe the processes and reactions that occur in biological systems.
6. Evaluate how dangerous biological samples and reagents are in a specific framework.
7. Explain the molecular bases of the organisation of living beings.
8. Identify the mechanisms that regulate the vital functions of living beings.
9. Identify the risks associated with the handling of biological samples and reagents.
10. Identify the risks involved in the handling of chemical compounds used in biological chemistry, and apply suitable protocols for the storage or elimination of the waste generated.
11. Learn autonomously.
12. Manage, analyse and synthesise information.
13. Manage the organisation and planning of tasks.
14. Obtain information, including by digital means.
15. Propose creative ideas and solutions.
16. Reason in a critical manner
17. Resolve problems and make decisions.

18. Show initiative and an enterprising spirit.
19. Show sensitivity for environmental issues.
20. Study enzymatic catalysis by means of modelling methods.
21. Use IT to treat and present information.
22. Use suitable strategies to handle and eliminate certain biological materials.
23. Work in a team and show concern for interpersonal relations at work.

Content

THEORY

Topic 0. General introduction: biomolecules and cells

General introduction to the main macromolecules: mono- and polysaccharides, amino acids and proteins, lipids and lipid derivatives. Different cellular compartments and basic functions of organelles and structures.

Topic 1. Basic concepts of metabolism

Introduction to metabolism. Sources of energy and carbon in living organisms. Concept of homeostasis. Metabolism and metabolic pathways. Phases of metabolism. Free energy in biological processes. Coupled reactions. Role of ATP and other phosphorylated compounds in metabolism. Oxidation-reduction reactions in biochemical processes. Role of electron carriers in metabolism. Experimental methods for the study of metabolism.

Topic 2. Basic concepts of metabolic regulation

Control of metabolic pathways. Enzymes and enzyme kinetics. Regulation of enzyme activity. Enzyme inhibitors. Allosteric enzymes. Regulation by covalent modification. General aspects of gene expression regulation. Control and compartmentalization of metabolic pathways.

Topic 3. Cell signaling

Characteristics of signal transduction processes. Hormones, neurotransmitters, and other primary messengers. Membrane and intracellular receptors. Molecular mechanisms of signal transduction. Integration of effects at the cytoplasmic and nuclear levels.

Topic 4. Carbohydrate metabolism

Glucose degradation: glycolysis and the pentose phosphate pathway. Fermentation. Gluconeogenesis. Glycogen synthesis and degradation. Utilization of other carbohydrates. Coordination and control of glucose and glycogen metabolism: importance of metabolic specialization in tissues.

Topic 5. Central pathways of oxidative metabolism

Metabolic pathways leading to the formation of acetyl-CoA. Pyruvate dehydrogenase complex. Citric acid cycle. Energy yield and regulation. Anaplerotic reactions. Amphibolic nature of the cycle: connections with biosynthetic pathways. Glyoxylate cycle.

Topic 6. Electron transport and oxidative phosphorylation

Mitochondrial electron transport chain. Origin and use of reduced substrates. Chemiosmotic coupling: ATP synthase and oxidative phosphorylation. Mitochondrial transport systems. Regulation of oxidative phosphorylation. Energy balance of oxidative metabolism (example of glucose). Uncoupling proteins and thermogenesis.

Topic 7. Photosynthesis

Basic process of photosynthesis. Photosynthetic pigments. Light energy absorption. Electron transport and photophosphorylation. CO_2 assimilation and photosynthetic carbohydrate biosynthesis (Calvin cycle). Regulation of photosynthesis. Photorespiration and the C4 cycle.

Topic 8. Lipid metabolism

Use of triacylglycerols in animals. Lipoprotein metabolism. Description and regulation of the fatty acid oxidation pathway. Ketogenesis. Description and regulation of the fatty acid biosynthesis pathway. Biosynthesis of triacylglycerols and phospholipids. Cholesterol metabolism and its derivatives.

Topic 9. Nitrogen compound metabolism: amino acid and nucleotide metabolism

Nitrogen cycle. General features of amino acid synthesis and degradation. Fate of amino acid carbon atoms. Ammonia elimination and urea cycle. Synthesis of biologically relevant amines. Formation of creatine and phosphocreatine. Heme metabolism. General features of purine and pyrimidine nucleotide metabolism. Biomedical applications of nucleotide analogs: chemotherapy and cancer.

Topic 10. Metabolic integration

Metabolic specialization of tissues. Metabolic features of the liver, muscle, and adipose tissue. Metabolic adaptations to various pathophysiological situations: changes associated with different nutritional states, exercise, and stress effects. Metabolic alterations in diabetes and obesity.

Activities and Methodology

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Classes of problem resolution	7	0.28	2, 11, 3, 18, 5, 4, 20, 12, 13, 14, 16, 17, 21
practice sessions in the laboratory	8	0.32	1, 11, 18, 20, 12, 13, 9, 10, 14, 15, 16, 17, 21, 22, 6
Theoric classes	36	1.44	2, 11, 3, 5, 4, 12, 13, 8, 14, 16
Type: Supervised			
Tutor sessions	2	0.08	3, 5, 12, 13, 15, 16
Type: Autonomous			
resolution of the proposed questionnaire	10	0.4	11, 3, 20, 12, 13, 14, 15, 16, 17, 21
Problem solving	17	0.68	11, 3, 5, 20, 12, 13, 8, 14, 16, 17, 21
Study	40	1.6	11, 3, 5, 4, 20, 7, 12, 13, 8, 14, 16

Methodology

The training activities are divided into three sections: theoretical classes, problem-solving classes, and laboratory practices, each with its own specific methodology. These activities will be complemented by a series of tutoring sessions scheduled additionally. Below is a description of the organization and teaching methodology that will be followed in each of these types of activities.

Theoretical Classes

The content of the theoretical program will be delivered primarily by the teaching staff in the form of lectures with audiovisual support. The presentations used by the teaching staff will be available to students on the course's Virtual Campus before the start of each topic. This part will be completed with interactive activities such as Socrative, which will be held exclusively presential in class, and participation will be valued.

Problem-Solving Classes

Throughout the course, 7 hours will be dedicated to problem-solving sessions.

The problem statements will be delivered through the Virtual Campus. These classes aim to consolidate the content covered in the theoretical classes, as well as familiarize students with some experimental strategies used in biochemistry, the interpretation of scientific data, and the resolution of problems based on real experimental situations.

Laboratory Practices

Each morning and afternoon group will be subdivided into smaller groups, the lists of which will be announced during the first weeks of the course. To ensure the smooth running of the practical sessions, group changes will only be accepted if properly justified.

Attendance at the practical sessions is mandatory, andstudents must wear a lab coat, splash-proof goggles, and bring a printed and pre-read lab protocol (available on the Virtual Campus).

The practices, as well as their assessment, will be conducted in groups. After each session, a questionnaire/report with the experiment results and answers to the proposed questions must be submitted. Attendance at the practical sessions is mandatory, except in cases with proper documentary justification.

SAFETY NOTICE IN THE LABORATORY

Any student involved in an incident with potential serious safety consequences may be expelled from the laboratory and fail the course.

Mentorship

The objective of these sessions is to resolve doubts, review basic concepts not covered in class, and provide guidance on consulted information sources. These sessions will not be expository, nor will they cover official syllabus content in advance; they will be debate and discussion sessions. Individual tutoring sessions will be conducted upon student request.

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.

Assessment

Continous Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Participating in theory and problem-solving classes	5%	5	0.2	5, 20, 12, 15, 17, 23
Presence in laboratory sessions and report elaboration	10%	18	0.72	1, 2, 11, 3, 18, 20, 12, 13, 9, 10, 19, 14, 15, 16, 17, 23, 21, 22, 6
Problems delivered in class	5%	1	0.04	12, 16, 17, 23
Two midterm problem exams	10%	2	0.08	3, 5, 7, 8, 15, 16, 17

Two midterm theory exams.	70%	4	0.16	3, 5, 4, 20, 7, 12, 13, 8, 16, 17

Theory

Individual assessment through:

- Two partial exams with multiple-choice questions and/or short-answer questions. There are no prerequisites to take any of the scheduled exams. The total weight of these midterm exams will be 70% of the final grade (35% each).

Problem-solving

Individual assessment through:

- Two exams covering problems held on the same day as the first and second midterm exams, respectively. This will account for 10% of the final grade (5% each exam).

Group assessment through:

- Problem sets delivered in class. These will count for 5% of the final grade.

Laboratory work

Group assessment through:

- Submission of results obtained during the lab sessions and completion of the proposed questionnaire. Attitude and behavior during lab sessions will also be evaluated.

Attendance at laboratory sessions is mandatory.

The weight of the lab assessment is 10% of the total grade.

To pass the course, students must obtain an overall grade of at least 5 out of 10 and a minimum score of 3.5 in each of the two partial exams and in the problem-solving test. If any of these scores is below 3.5, the maximum final grade will be 3.5 out of 10.

Single assessment

Students who choose the single assessment system will take the full theory exam on the same day as the second continuous assessment exam. It will have the same format and count for 70% of the final grade. On the same day, a problem-solving exam will be conducted, accounting for 15%.

If students score below 3.5 in any of these exams or if the combined grade (theory, problems, and lab) is below 5, they must take the resit exam to meet the minimum criteria to pass. Attendance to lab sessions and report submission is mandatory.

Resit exam

To take part in the resit, students must have previously been assessed in a set of activities that represent at least two-thirds (67%) of the final grade. If the completed assessment activities represent less than 67% of the final grade, the student will be marked as "Not Assessable".

On the same day, specific resit exams will be offered for the first and second partial exams and for problem-solving, for students needing to retake any part.

The grades obtained in the resit exams will replace the original partial exam grades. For parts not retaken, the original score will be used. If any of these grades is below 3.5,the maximum final grade will be 3.5 out of10.

Additional considerations

Students who cannot attend an individual assessment due to a justified reason (e.g., illness, death of a first-degree relative, or accident) and who provide official documentation to the Degree Coordinator will be allowed to take the exam on another date.

For this course, the use of Artificial Intelligence (AI) tools is not allowed in the preparation of lab reports. Their use is permitted for support tasks such as literature search, proofreading, or translations. Lack of transparency in AI use for this graded activity will be considered academic dishonesty and may lead to a partial or total penalty in the grade, or more serious sanctions in severe cases.

Bibliography

In response to the demand for offering as many remotely accessible resources as possible, some examples of fully online-accessible bibliography have been selected via "ARE UAB" (https://www-uab-cat.are.uab.cat/biblioteques/). Many more books are available, but a few have been preselected.

Nelson, D.L. and Cox, M.M. *Lehninger - Principles of Biochemistry* (2014), 6th ed. Ed. Omega. Translated from the 6th English edition (2013). The 7th English edition (2017) is also available. Ed. W.H. Freeman.
https://bibcercador.uab.cat/permalink/34CSUC_UAB/1c3utr0/cdi_askewsholts_vlebooks_9781319322397

Berg, Jeremy M.; Tymoczko, John L.; Stryer, Lubert. *Biochemistry: with Clinical Applications*. Ingebook (UAB), 2013.
ISBN: 9788429194128 (online). 7th ed., Editorial Reverté
https://bibcercador.uab.cat/permalink/34CSUC_UAB/avjcib/alma991009089459706709

Fromm, Herbert J. *Essentials of Biochemistry*
ISBN: 978-3-642-19623-2. Springer
https://bibcercador.uab.cat/permalink/34CSUC_UAB/1c3utr0/cdi_askewsholts_vlebooks_9783642196249

Gerald Litwack. *Human Biochemistry*
ISBN: 978-0-12-383864-3. Academic Press
https://bibcercador.uab.cat/permalink/34CSUC_UAB/1c3utr0/cdi_proquest_ebookcentral_EBC6818682

Donald Voet. *Fundamentals of Biochemistry: Life at the Molecular Level*
ISBN: 978-607-9356-96-5
https://bibcercador.uab.cat/permalink/34CSUC_UAB/1eqfv2p/alma991007007959706709

Software

There is no specific software associated with this course. The use of Excel will be required for the analysis of the practical results.

Groups and Languages

Please note that this information is provisional until 30 November 2025. You can check it through this link. To consult the language you will need to enter the CODE of the subject.

Name	Group	Language	Semester	Turn
(PAUL) Classroom practices	1	Catalan	second semester	morning-mixed

(PAUL) Classroom practices	2	Catalan	second semester	morning-mixed
(PLAB) Practical laboratories	1	Catalan/Spanish	second semester	morning-mixed
(PLAB) Practical laboratories	2	Catalan/Spanish	second semester	morning-mixed
(PLAB) Practical laboratories	3	Catalan/Spanish	second semester	afternoon
(PLAB) Practical laboratories	4	Catalan/Spanish	second semester	afternoon
(TE) Theory	1	Catalan	second semester	morning-mixed
(TE) Theory	2	Catalan	second semester	afternoon