Biochemistry

Code: 100938
ECTS Credits: 9

2025/2026

Degree	Type	Year
Biotechnology	FB	1

Contact

Name: Maria Plana Coll

Email: maria.plana@uab.cat

Teachers

Javier Garcia Pardo

Teaching groups languages

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

Prerequisites

There are not prerequisites to follow the course successfully. Nonetheless it would be desirable if students were familiar with basic knowledge of biology and chemistry.

Much of the literature is in the English language, which is also used in the figures projected in theory classes.

Objectives and Contextualisation

The subject Biochemistry includes a first part that explains the structural and functional characteristics of biomolecules, with a special emphasis on proteins and enzymes. The second part focuses on understanding bioenergetics, biosignaling and the main routes of metabolism. The general objective of this subject is to provide the basis of the biochemistry that are considered necessary for understanding specific subjects of the Degree in Biotechnology.
Specific objectives of the subject:
- To understand the structural characteristics of biological molecules, knowing how to draw conclusions about their stability, their function and their capacity for replication of structures.
- To understand the concepts of enzyme activity and kinetics in the context of biological reactions and their regulation.
- To describe the general mechanisms through which living organisms obtain and transform the energy of the environment.
- To know the main molecular mechanisms of biosignaling.
- To describe the main routes of intermediate metabolism of glucose, lipids and nitrogen compounds, their regulation and coordination.
- To know how to apply the knowledge to solve qualitative and quantitative problems.

Learning Outcomes

1. CM15 (Competence) Work collaboratively in teams to solve problems in the field of biochemistry.
2. KM13 (Knowledge) Describe the principles of bioenergetics and enzymatic catalysis.
3. KM14 (Knowledge) Accurately describe the molecular bases of protein folding, trafficking, modification, and turnover.
4. SM14 (Skill) Correctly interpret data and observations in the field of biochemistry.
5. SM14 (Skill) Correctly interpret data and observations in the field of biochemistry.
6. SM15 (Skill) Analyse three-dimensional structures of macromolecules.

Content

Lesson 1. Molecular elements and physical environment of living organisms.

Concept of biochemistry. Chemical elements in living organisms. Biomolecules. Structural hierarchy in the molecular organization of cells. Non-covalent interactions in aqueous systems. Biological relevance of water. Water ionization, ionic equilibrium and buffer systems.

Lesson 2. Bioenergetics principles.

Production and use of metabolic energy. Universality of the thermodynamics principles. Life as a process far from equilibrium; biochemical reactions and free energy. Basic processes in bioenergetics: Phosphate transfer and redox reactions. ATP and other phosphorylated compounds. Electron carriers.

Lesson 3. Proteins: primary structure and biological functions.

Protein types and functions. Amino acids structure and properties. Classification. Peptides and peptide bond. Composition and amino acid sequence of proteins. Protein sequence databases. Sequence alignments.

Lesson 4. 3D protein structure.

Levels of protein structure. Description of helix and folded sheets. Fibrous proteins. Globular proteins. Quaternary structure. Protein folding: key factors; chaperones. Conformational diseases. Prions. Protein structure prediction.

Lesson 5. Function and evolution of proteins: oxygen binding proteins.

Oxygen storage: Myoglobin. Oxygen transport: Hemoglobin. Hemoglobin and cooperativity. Analysis of cooperativity. Hemoglobin variants: physiological adaptation and molecular pathology. Examples of protein evolution.

Lesson 6. Carbohydrates.

Types and functions. Monosaccharides, description and properties. Glycosidic bond. Oligosaccharides. Polysaccharides. Glycoproteins and glycolipids. Carbohydrates as information carrier molecules.

Lesson 7. Lipids and biological membranes.

Lipid types and functions. Fatty acids. Storage and membrane lipids. Cholesterol and derivatives. Fat soluble vitamins. Eicosanoids. Lipoprotein structure and function. Biological membranes.

Lesson 8. Biological catalysts.

Nature and function. Enzyme classification and nomenclature. Catalytic effects in chemical reactions: general mechanisms. Description of enzymatic mechanisms. Initial velocity. Enzyme kinetics: the hypothesis of

Michaelis-Menten. Enzyme cofactors. Two substrate reactions. Enzyme inhibition. Regulation of enzyme activity: allosteric changes, covalent modifications and changes in the enzyme concentration. Biomedical and biotechnological applications.

Lesson 9. Nucleic acids: Structure levels.

Nucleic acids: nature and function. Nucleotides. The primary structure of nucleic acids. Secondary structure: the model of Watson and Crick and alternative models. Tertiary structure: DNA supercoiling and transfer RNA. Protein-DNA complex: chromosome organization. DNA denaturation and renaturation.

Lesson 10. Introduction to metabolism.

Concept of metabolism and metabolic pathways. Metabolism stages. Control and compartmentalization of metabolic pathways. Experimental approaches for metabolism study.

Lesson 11. Biosignaling.

Hormones, neurotransmitters and other primary messengers. Membrane and internal cell receptors. Molecular mechanisms for signal transduction: receptor enzymes, G protein-coupled receptors and ion channels. Second messengers. Integrated response of different signals both at cytoplasm and nucleus levels.

Lesson 12. Carbohydrate metabolism (1).

Glucose metabolism. Glycolysis. Fermentations. Feeder pathways for glycolysis. Gluconeogenesis. Coordinated regulation of glycolysis and gluconeogenesis. The pentose phosphate pathway.

Lesson 13. Carbohydrate metabolism (2).

Glycogen metabolism: synthesis, breakdown and coordinatedregulation. Coordination in the metabolic control of glucose and glycogen: relevance of metabolic tissue specialization.

Lesson 14. Core routes in oxidative metabolism.

Acetyl-CoA production. Citric acid cycle. Energy balance and control. Anaplerotic reactions. Glyoxylate cycle.

Lesson 15. Electron transport and oxidative phosphorylation.

Mitochondrial electron transport chain. Origin and utilization of reduced substrates. Chemiosmotic coupling: ATP synthase and oxidative phosphorylation. Mitochondrial transport systems. Oxidative phosphorylation control. Energy balance of the oxidative metabolism.

Lesson 16. Photosynthesis.

Basic processes in photosynthesis. Photosynthetic pigments. Energy absorption of light. Electron transport and phosphorylation. CO_2 assimilation and Calvin cycle. Photosynthesis control. Photorespiration.

Lesson 17. Lipid metabolism.

Triglycerides use in animals. Lipoproteins. Description and control of the fatty acid oxidation pathway. Ketogenesis. Description and control of fatty acid biosynthesis pathway. Triglyceride and phospholipid biosynthesis. Cholesterol metabolism.

Lesson 18. Nitrogen compounds metabolism.

Nitrogen cycle. Intracellular degradation of proteins. Basic mechanisms of amino acid degradation. Fate of the carbon skeleton. Ammonia excretion and the urea cycle. Amino acid biosynthesis. Nucleic acid and nucleotide degradation. Nucleotide recovery and *de novo* synthesis. Biomedical applications of nucleotide analogs.

Lesson 19. Metabolism Integration.

Coordination of metabolism between liver, muscle, adipose tissue and brain. Main control hormones. Stress and metabolism adaptation.

Activities and Methodology

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Classes of problem resolution	15	0.6	CM15, KM13, KM14, SM14, SM15, CM15
Theory classes	55	2.2	CM15, KM13, KM14, SM14, SM15, CM15
Type: Supervised			
Tutor sessions	0	0	KM13, KM14, SM14, SM15, KM13
Type: Autonomous			
Individual work	105	4.2	KM13, KM14, SM14, SM15, KM13
Learning exercises	39	1.56	CM15, KM13, KM14, SM14, SM15, CM15

Biochemistry consists of theoretical classes, classes of resolution problems and tutor sessions. The following describes the organization and the teaching methodology that will be followed in these three types of training activities.

Theory classes:

The content of the theory program will be taught mainly by the teacher in the form of master classes with audiovisual support. Presentations used in class by the teacher will be previously available on the Virtual Campus of the subject. It is recommended to have this material as a class support. It is advisable to consult the recommended books in the Bibliography section of this teaching guide regularly to consolidate and clarify, if necessary, the contents explained in class. It is also advisable to use the links that are indicated in the presentations of the different themes and that contain videos and animations related to the processes explained in class.

Problem classes:

In these sessions the class group will be divided into two groups (A and B). You need to consult which group you belong to and attend the corresponding classes.

These sessions are scheduled during the second semester of the course and will be devoted to the resolution of experimental problems related to the contents of the theory program. It is intended that these classes serve to consolidate the contents previously worked in theory classes and also facilitate the knowledge of the techniques used in biochemistry, the interpretation of scientific data and the resolution of problems based on real experimental situations.

The collection of problems that will need to be worked out will be available on the Virtual Campus.

Tutor sessions

Individual tutorials will be carried out at the request of the students. In the event that the number of applications was high, especially in the face of partial exams, a classroom tutoring could be held before each partial, which

would be announced ona timely basis through the Virtual Campus. The objective of these sessions will be to resolve doubts, review basic concepts and guide the sources of information consulted.

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
Partial exams	80	8	0.32	CM15, KM13, KM14, SM14, SM15
Problem solving	20	3	0.12	CM15, KM13, KM14, SM14, SM15

The evaluation of this subject will be done with three partial tests and two tests of problem solving.

Individual assessment through:

- Three partial tests with quiz questions and short answer questions. The first one has a weight of 26% of the overall grade. The other two have a weitght of 27% of the overall grade. Minimum score of each test: 3,5 out of 10.
- Two problem-solving tests that will be done on the days of the second and third partial tests. Each one has a weight of 10% of the overall grade. Minimum score of each test: 3,5 out of 10.
-To participate in the recovery the students must have been previously evaluated in a set of activities whose weight equals to a minimum of two thirds of the total grade of the subject and have obtained a minimum qualification in the average of the subject of 3.5.
-In the case where scores of more than 3,5 have been obtained and the qualifications obtained in one of the partial tests or problem-solving tests are desired, the day in which the recoveries are called, the examination of the part can be carried out corresponding It must be borne in mind, however, that the fact of carrying out one of these recovery tests implies the renunciation of the previous qualification

Global assessment of the subject:

To pass the subject, you must obtain a global grade equal to or greater than 5 points out of 10 and the minimum grade of 3,5 in the three partial tests and the two for solving problems. If in any of these tests the qualification is less than 3,5, the final maximum grade will be 3,5 points out of 10.

The students will obtain the "Non-Valuable" qualification when the evaluation activities carried out have a weighting of less than 67% in the final grade.

Examination-based assessment.

Single assessment consists of a single examination that includes the contents of the entire theory program worth 80% and another examination on problem-solving questions worth 20% of the final grade. The mark obtained in this synthesis test is 100% of the final grade of the subject.

The single assessment examination coincides with the date set in the calendar for the last continuous assessment examination (partial third assessment). The same recovery system will be applied as for continuous assessment.

Bibliography

- Murray, R.K. et al. *Harper's Illustrated Biochemistry* (2015). 30th edition. Mc Graw Hill Education.

- Nelson, D.L. and Cox, M.M. *Lehninger-Principles of Biochemistry* (2021). 8th edition. Macmillan Learning.

- Jeremy Berg; Gregory Gatto Jr.; Justin Hines; John L. Tymoczko; Lubert Stryer *Biochemistry* (2023). 10th edition.

- Tymoczko, J.L., Berg, J.M. and Stryer L. *Bioquímica. Curso básico* (2014). Ed. Reverté. Traduït de la 2ª edició (2013). W.H. Freeman and Co.

- Tymocsko, J.L., Berg, J.M. and Stryer, L. *Biochemistry: A Short Course* (2016). 3rd edition. Macmillan Learning, W.H. Freeman and Co.

- Donald Voet, Judith G. Voet, Charlotte W. Pratt "Fundamentals of Biochemistry: Life at the Molecular Level," 5th Edition. Wiley ed. ISBN: 978-1-118-91840-1

web links

actualized in the moodle

Software

No specific software is required

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	411	English	annual	afternoon
(PAUL) Classroom practices	412	English	annual	afternoon
(TE) Theory	41	Catalan/Spanish	annual	morning-mixed