Biochemistry I

Code: 103266
ECTS Credits: 6

2025/2026

Degree	Type	Year
Food Science and Technology	FB	1

Contact

Name: Asier Gonzalez Sevine

Email: asier.gonzalez@uab.cat

Teachers

Anna Maria Bassols Teixido

Antonio Jesus Casamayor Gracia

Teaching groups languages

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

Prerequisites

There are no official prerequisites. However, it is advisable to review the basic contents of Biology and Chemistry of the first semester and of the Baccalaureate.

Objectives and Contextualisation

This subject should allow students to understand that biological processes, especially those related to food and metabolism, have a chemical basis and that can be explained in these terms.

Students must understand the structural bases of these processes, as well as the structural bases that explain the function in the different types of biological compounds: carbohydrates, lipids, proteins, vitamins, and trace elements, and nucleic acids.

Likewise, students must understand the molecular basis of the transmission of genetic information and its regulation, as well as its applications in food biotechnology.

The specific goals are to identify and understand:

- The structure and function of proteins, carbohydrates, lipids, nucleotides, and vitamins.
- The structure of nucleic acids and the processes of replication, transcription, translation, and regulation of gene expression.

- The foundations and applications of the main Biochemistry and Molecular Biology techniques and methodologies.

With a special focus on Food Science and Technology.

Competences

- Adopt an ethical stance and attach importance to quality in work.
- Analyse, summarise, resolve problems and make professional decisions.
- Apply knowledge of the basic sciences to food science and technology.
- Apply the scientific method to resolving problems.
- Communicate effectively with both professional and non-professional audiences, orally and in writing, in the first language and/or in English.
- Develop individual learning strategies and planning and organisation skills.
- Display knowledge of nutrients, of their bioavailability and function in the organism, and the bases of nutritional balance.
- Display knowledge of the physical, chemical, biochemical and biological properties of raw materials and foods.
- Search for, manage and interpret information from different sources.
- Stay abreast of new knowledge, adapt to new situations and develop creativity.
- Use IT resources for communication, the search for information within the field of study, data processing and calculations.

Learning Outcomes

1. Adopt an ethical stance and attach importance to quality in work.
2. Analyse, summarise, resolve problems and make professional decisions.
3. Apply the fundamental principles and the applications of biochemistry to food biotechnology.
4. Apply the scientific method to resolving problems.
5. Communicate effectively with both professional and non-professional audiences, orally and in writing, in the first language and/or in English.
6. Describe mechanisms of transmission and regulation of genetic information in the cell.
7. Describe the reactions of reaction, kinetics and enzyme regulation.
8. Develop individual learning strategies and planning and organisation skills.
9. Establish the metabolic role of vitamins, oligoelements and other essential nutrients.
10. Explain the structures and properties of the principal biological molecules.
11. Search for, manage and interpret information from different sources.
12. Stay abreast of new knowledge, adapt to new situations and develop creativity
13. Use IT resources for communication, the search for information within the field of study, data processing and calculations.

Content

THEORY LECTURES

PART 1. THE CHEMISTRY OF LIFE

Unit 1. Introduction to the chemistry of living organisms. Biomolecules. Properties of water and importance of the aqueous environment for living organisms.

Unit 2. Constituents of proteins: amino acids. Structure and properties.

Unit 3. Amino acid sequence of proteins. The peptide bond. The primary structure of proteins. Sequencing of peptides.

Unit 4. Three-dimensional structure of proteins. Secondary structure. The α-helix and the β-sheet. Tertiary structure. Quaternary structure. Structural domains. Native conformation and denaturalization.

Unit 5. Fibrous proteins. α-keratin, collagen, and others.

Unit 6. Oxygen-transport proteins. Structure of myoglobin and hemoglobin. The oxygen binding center. Cooperativity and allosterism. Allosteric effectors.

Unit 7. Catalytic proteins: enzymes. General properties. Classification. Substrates and coenzymes or cofactors. Isozymes. Enzymatic catalysis.

Unit 8. Enzyme kinetics. The Michaelis-Menten equation. Meaning of Km and Vmax. Effects of pH and temperature on enzymatic activity. Enzyme inhibition. Main mechanisms of catalysis.

Unit 9. Mechanisms of regulation of enzymatic activity. Regulation of enzyme concentration. Allosteric enzymes. Reversible covalent modification. Protein-protein interaction. Changes in subcellular localization. Irreversible covalent modification (proteolysis).

Unit 10. Biochemical study of carbohydrates. Generalities. Families of monosaccharides. Natural oligosaccharides. Reserve polysaccharides and structural polysaccharides.

Unit 11. Biochemical study of lipids. Fatty acids. Triglycerides. Phosphoglycerides. Sphingolipids and glucolipids. Cholesterol

Unit 12. Vitamins and trace elements. Structure, function, requirements and avitaminosis.

PART 2. REPLICATION, TRANSCRIPTION, PROTEIN SYNTHESIS (TRANSLATION) AND THEIR REGULATION

Unit 13. Nucleotides and derivatives. Purines and pyrimidines and their nucleotides. Nucleotides as enzymatic cofactors. Cyclic AMP.

Unit 14. Nucleic Acids. DNA and its structure. Nucleotide equivalence. Double helix. Nucleosomes.

Unit 15. DNA replication. Semiconservative replication. DNA polymerases. Okazaki fragments. DNA replication: initiation, elongation, and termination. DNA repair.

Unit 16. RNA and transcription. RNA polymerase and synthesis of RNAs. Prokaryotic and eukaryotic promoters. Post-transcriptional modifications of rRNA and tRNA. Processing of mRNA in eukaryotes. Introns and splicing.

Unit 17. Control of gene expression. Gene induction and repression. lac operon. Control of gene expression in eukaryotes.

Unit 18. Genetic code. The nature and main features of the genetic code. Nucleotide triplets. tRNA as an adapter in protein synthesis.

Unit 19. Protein synthesis. Activation of amino acids. Characteristics of aminoacyl-tRNA synthetases. Initiation, elongation, and termination. Introduction to protein synthesis in eukaryotes.

Unit 20. Introduction to Food Biotechnology. Introduction to recombinant DNA techniques. Biotechnological applications of bacteria, yeasts, plants and animals. Analytical techniques: PCR, antibodies, biosensors.

<u>LABORATORY PRACTICAL SESSIONS</u>

Practical session 1. Separation of a mixture of amino acids by ion exchange chromatography and identification by thin layer chromatography.

Practical session 2. Enzymes: determination of the Km.

Practical session 3. Computer room: Bibliographic databases, research articles, and artificial intelligence (AI) tools.

Practical session 4. (2 days). Applications of PCR to Food Biotechnology.

SEMINARS

Seminar 1. Chromatographic techniques.

Seminar 2. Spectrophotometric techniques.

Seminar 3. Enzymatic analysis.

Seminar 4. Protein purification.

Seminar 5. PCR, cloning, and expression of recombinant proteins.

Seminar 6. Next Generation Sequencing techniques and their applications.

Activities and Methodology

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Laboratory practical sessions	12	0.48	2, 4, 3, 1, 8, 10
Seminars and problem solving	6	0.24	2, 4, 3, 9, 10
Theory lectures	31	1.24	2, 4, 3, 1, 7, 6, 9, 10
Type: Supervised			
Self-learning preparation	22.5	0.9	3, 1, 11, 5, 7, 6, 8, 9, 10, 13
Type: Autonomous			
Study and bibliographic search	74	2.96	2, 4, 3, 11, 7, 6, 8, 9, 10, 13

The methodology of the learning process combines i) theoretical classes where the teachers expose the most relevant aspects of each subject with ii) active self-learning by the students on topics of interest. The subject is based on the following activities:

- Presential lectures with ICT support explaining the basic concepts of the subject. Kahoot, among others, will be used as a game-based learning tool.
- Seminars and problem solving-oriented lectures: Presentation by the teachers of specific topics and discussion in small groups.
- Laboratory practical sessions: Acquisition of work skills in the laboratory and experimental understanding of concepts explained in pressential classes and seminars.

- Autonomous work of the students, individually or in groups, for the preparation of topics proposed by the teachers or by the students. This work involves the search and selection of information in various sources of scientific databases. Presentations are public, must include multimedia material and ICT support, and are followed by a discussion.

Some lectures may be given as flipped classes (flipped classroom), i.e., students will need to follow the corresponding video for the topic during non-presential hours, and during the class time problems will be solved and doubts will be addressed.

Questions and/or activities can be proposed through the moodle classroom (*campus virtual*).

Use of AI: Permitted use.

In this course, the use of AI technologies is allowed as an integral part of the development of the work, provided that the final result reflects a significant contribution from the student in terms of analysis and personal reflection. Students must clearly identify which parts have been generated using this technology, specify the tools used, and include a critical reflection on how these have influenced the process and the final outcome of the activity. Lack of transparency in the use of AI will be considered academic dishonesty and may result in a penalty in the activity grade, or more severe sanctions in serious cases.

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
Exam of laboratory practices	10	0	0	2, 4, 5, 13
Partial and final exams	70	2	0.08	2, 3, 1, 7, 6, 8, 9, 10
Presentation and discussion of self-learning project	20	2.5	0.1	2, 4, 3, 11, 5, 7, 6, 9, 10, 12, 13

The maximum score is 10 points. Students will pass the subject with an overall score of 5.0 or higher.

The evaluation system is organized in three modules. The final qualification is obtained with the sum of the qualifications of the different modules, with the conditions described below.

Module 1. Theory, seminars, and problems.

- Evaluation system: test with multiple choice answers.

- Weight in the global rating: 70%.

Students may opt for partial tests. There will be two partial tests throughout the semester. The first test will include unit 1 to approximately unit 12 (depending on the specific calendar). Part 2 includes from approximately unit 13 to the last unit. Each test will consist of approximately 25-30 test-type questions for each partial. Questions about seminars will be included.

In the case of obtaining a minimum mark of 4,5 in each partial exam, the mean of the two scores will be calculated. If the average score of the two partial exams is equal to or greater than 5, the final score will be obtained by the sum of the average of the two partials (weight 70%), the score of the practical session exam (weight 10%) and the score of self-learning activity (20% weight). If this number is equal to or higher than 5,

the grade is "Pass". If the sum is less than 5, the final grade will be "Failed". in the case that the mark is "Failed" but the average grade of the two exams higher or equal 5, the student may retake the test to improve the mark and to pass the subject. The student will have to agree with the teachers which partial exam is to be retaken.

If the average of the two partial exams is less than 5, the student will have to retake the partial/partials with a score less than 5. In case that onlya partial shouldbe retaken, the grade must be equal or higher than 4.5 (out of 10). The final mark will be calculated fromthe sum of the average of the two partials (weight: 70%), the mark of the practical session exam (weight: 10%) and the mark of the self-learning activity (weight: 20%). If this number is equal to or higher than 5, the grade is Passed. If the sum is less than 5, the final grade will be Failed.

If in the retake of the partial exam the student obtains a mark less than 4.5 (out of 10), the partial exams will not compensate and therefore, the final qualification will be Failed.

In case the student must retake the two partial exams, the exam will be of all the subject (Module 1: theory + seminars). The exam will be corrected as a single test. The minimum mark in the recovery exam must be 4.5 (out of 10). A score lower than 4.5 represents a "Failed" as the final grade.

If the mark of the retaken exam is equal to or higher than 4,5 (out of 10), the final mark will be obtained by the sum of the retake exam (weight: 70%), the mark of the practical session exam (weight: 10%) and the mark of self-learning activity (weight: 20%). If this number is equal to or greater than 5, the final grade will be "Pass". If the sum is less than 5, the final grade will be "Failed".

Module 2. Laboratory practices

Laboratory practices are mandatory. The student who has not completed them or does not present the poster will be qualified as Not Presented or Failed, depending on their situation, regardless of the score that they have obtained in the exam.

- Assessment system: design and construction of a poster about one laboratory practice (chosen by the teacher).

- Weight in the global rating: 10% (Maximum score: 1,0).

Module 3. Self-learning activity

The self-learning activityis compulsory and, therefore, the student who do not takeit will be graded as "Not Presented" or "Failed", depending on their situation and regardless of the grade that they have obtained in the exam.

- Evaluation system: work presented.

- The written and oral presentation will be evaluated, as well as the competence when discussing the topic.

- Weight in the global rating: 20% (Maximum score: 2,0).

Retake exam

In the retake exam, the student will be able to take the failed partial exam or both (obligatory or voluntarily) corresponding to Module 1. The obtained score, which will represent 70% of the final grade, will be added to the marks obtained in Modules 2 and 3 as indicated above.

Regardless of the score obtained in the partial tests, any student may choose to attend the retake exam to obtain a higher mark. In this case, the mark will be the one from the last exam.

Not gradable

A student is not gradable if it has participated in assessment activities that represent $\leq$ 15% of the final grade

Single assessment

Students who take the single assessment must do the laboratory practical sessions in the in-person sessions at the time set in the calendar. Attendance and in-person presentation of the work corresponding to Module 3 (Self-Learning activity) is also mandatory, and the student will have to attend the entire session on the indicated day. The single assessment test will coincide with the same date fixed in the calendar for the last continuous assessment test. The presentation of the poster as an evaluation system for the practices and the evaluation of module 3 will take place on the day of the single assessment.

The same non-gradable criteria as for continuous assessment will be applied. The review of the final grade follows the same procedure as for the continuous assessment.

Bibliography

Main books

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- Nelson, D. L., & Cox, M. (2021). *Lehninger principles of biochemistry* (Eighth edition.). Macmillan International.
- Parkin, K. L., Damodaran, S., & Fennema, O. R. (2021). *Fennema's food chemistry. Castellà
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- Gil, Á., Sociedad Española de Nutrición Parenteral y Enteral., & Fundación Iberoamericana de Nutrición. (2017). *Tratado de nutrición* (3ª edición). Editorial Médica Panamericana.
- Harris, D. C., Barrachina, C., & Compañó, R. (2006). *Anàlisi química quantitativa* (1a ed.). Editorial Reverté.
- Skoog, D. A., West, D. M., Holler, F. J., & Crouch, S. R. (2015). *Skoog, Douglas A. Fundamentals of analytical chemistry. Castellà
Fundamentos de química analítica* (Novena edición). Cengage Learning.
- Petrucci, R. H., Herring, F. G., Madura, J. D., & Bissonnette, C. (2023). *Petrucci, Ralph H., General chemistry
Petrucci's general chemistry: principles and modern applications* (Twelfth edition). Pearson Education Limited.

Others

- Berg, J., Gregory, G., Justin, H., John, T., & Lubert, S. (2023). *Biochemistry* (10th ed.). W. H. Freeman & Company.
- Alberts, B. (2022). *Molecular biology ofthe cell* (Seventh edition, international student edition). W. W. Norton & Company.
- Lodish, H., Berk, A., Kaiser, C. A., Krieger, M., Bretscher, A., Ploegh, H., Martin, K. C., Yaffe, M., & Amon, A. (2021). *Molecular cell biology* (Ninth edition). Macmillan International Higher Education.
- Voet, D., Voet, J. G., & Pratt, C. W. (2016). *Fundamentos de bioquímica la vida a nivel molecular: 4a edición*. Médica Panamericana.
- Appling, D., Anthony-Cahill, S., & Mathews, C. (2018). *Biochemistry* (2nd ed.). Pearson Education, Limited.

Software

- Páginas de Bioquimica y Biologia Molecular: http://biomodel.uah.es/
- Protein Purification (Dr Andrew Booth, University of Leeds, UK): http://www.agbooth.com/pp_ajax/

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