

**Basic Molecular and Cell Biology**

Code: 102493  
ECTS Credits: 6

Degree	Type	Year	Semester
2502444 Chemistry	FB	1	1

### Contact

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### Use of languages

Principal working language: catalan (cat)  
Some groups entirely in English: No  
Some groups entirely in Catalan: Yes  
Some groups entirely in Spanish: No

### Teachers

Josep Antoni Biosca Vaqué  
Ester Boix Borrás  
Nerea Gaztelumendi Corcoles

### Prerequisites

There are not, but its is desirable knowledge on:

- 1) Biomolecules and their function
- 2) The structure and functions of cell organelles

### Objectives and Contextualisation

The subject Fonaments de Biologia Molecular i Cel·lular, is taught in the 1st semester of the 1st year of the Degree of Chemistry.

#### Objectives of the course:

- 1) To understand the basic structural features of biomolecules.
- 2) To know the mechanisms of expression and transmission of genetic information.
- 3) To know the methods of analysis and manipulation of biomolecules, as well as the basic techniques in biochemistry and molecular biology.
- 4) To describe the cell structure and ultrastructure.
- 5) To know the functions of cell organelles and other cellular structures and to understand that their coordinated functioning is essential for the development of cell tasks.

6) To know the processes of differentiation, specialization and cell death, their importance for the correct functioning of an organism and to understand the cellular bases of certain pathologies associated with errors of cell functioning.

## Skills

- "Interpret data obtained by means of experimental measures, including the use of IT tools; identify their meaning and relate the data with appropriate chemistry, physics or biology theories."
- Apply knowledge of chemistry to problem solving of a quantitative or qualitative nature in familiar and professional fields.
- Communicate orally and in writing in ones own language.
- Handle standard instruments and material in analytic and synthetic chemical laboratories.
- Have numerical calculation skills.
- Learn autonomously.
- Manage the organisation and planning of tasks.
- Reason in a critical manner
- Recognise and analyse chemical problems and propose suitable answers or studies to resolve them.
- Show an understanding of the basic concepts, principles, theories and facts of the different areas of chemistry.
- Use IT to treat and present information.
- Use the English language properly in the field of chemistry.
- Work in a team and show concern for interpersonal relations at work.

## Learning outcomes

1. Apply knowledge of biology to solve problems in biological chemistry.
2. Communicate orally and in writing in ones own language.
3. Describe the molecular mechanisms responsible for the replication and transcription of DNA, as well as the translation of mRNA and the regulation of genic expression.
4. Describe the processes of cellular differentiation, specialisation and death, as well as the cellular bases of pathologies associated to functional errors.
5. Have numerical calculation skills.
6. Identify structural protein domains and motifs and their functional and evolutionary relationships.
7. Integrate the functions of the different organelles and cell structures with the overall functioning of the cell.
8. Interpret the results of experiments performed in the biology laboratory.
9. Learn autonomously.
10. Make bibliographic enquiries in the field of biology in the English language.
11. Manage the organisation and planning of tasks.
12. Master the basic techniques for manipulating and analysing nucleic acids.
13. Properly describe the basic structural and functional characteristics of biomolecules.
14. Reason in a critical manner
15. Relate the methodologies used in cell biology to the knowledge these can provide, handle laboratory tools and make cell cultures
16. Relate the structure of the different parts of a cell to their functioning.
17. Select the most suitable experimental approaches to studying the structure and function of biomolecules
18. Use IT to treat and present information.
19. Use specific bibliographic sources on cellular biology to develop and expand the acquired knowledge.
20. Work in a team and show concern for interpersonal relations at work.

## Content

### Theory program

## ***Biochemistry and molecular biology***

Unit 1: Molecular organization of living beings: General concept of Biochemistry. Chemical elements in living matter. Structural hierarchy of biomolecules. Biological importance of water. Non-covalent interactions in aqueous medium.

Unit 2: Proteins: Primary structure and biological functions: Protein types and functions. Chemical structure, properties and classification of amino acids. Peptides and peptide bond.

Unit 3: Three-dimensional structure of proteins: Structural levels of proteins. Description of the  $\alpha$ -helix and  $\beta$ -sheets. Fibrous proteins. Globular proteins. Quaternary structure.

Unit 4: Biological catalysts: Nature and function. Classification and nomenclature. Bases of enzymatic action. General mechanisms of enzymatic catalysis. Enzyme kinetics. Cofactors. Regulation of enzyme activity.

Unit 5: Carbohydrates: Types of carbohydrates and their functions. Monosaccharides: description and properties. Glycosidic bond. Oligosaccharides. Structural and reserve polysaccharides. Glycoproteins: glycoproteins, proteoglycans and glycolipids.

Unit 6: Lipid: Types of lipids and functions. Storage lipids. Structural membrane lipids. Other lipid structures.

Unit 7: Nucleic acids: Types of nucleic acids and functions. Nucleotides. Primary structure of nucleic acids. Secondary structure: Watson and Crick models and alternative structures. Tertiary structure. DNA-protein complexes: chromosome organization.

Unit 8. Basic Concepts of Molecular Biology. DNA replication. Transcription of DNA. RNA processing. Regulation of gene expression. Translation: the genetic code, the ribosome and mechanism of protein synthesis.

## ***Cell biology***

Unit 9: Plasma membrane, structure and transport mechanisms. Cell junctions.

Unit 10: The internal membranous system. Vesicular transport. Endoplasmic reticulum, synthesis and modification of lipids and proteins. Golgi apparatus, structure and modifications of proteins. Selection and distribution of proteins for vesicular transport. Lysosomes and Endosomes.

Unit 11: Mitochondria, structure and functioning. Peroxisomes, diversity, structure and functioning.

Unit 12: Cytoskeletal elements, their role in cell functioning and tissue maintenance. Microfilaments, structure and function. Microtubules, structure and function. Intermediate filaments, structure and function.

Unit 13: Nuclear structure and transport nucleus-cytoplasm. Cell cycle and its control. Cell death. Cancer. Meiosis and recombination.

## **Problems**

### ***Biochemistry and Molecular Biology***

The content of this section consists of two parts. In the first, the most relevant aspects for the purification and characterization of proteins will be discussed. The second will be focused in buffer systems, methods of purification and analysis of macromolecules and enzyme kinetics. The problem statements will be delivered in the form of a dossier at the beginning of the semester.

### ***Cell Biology***

The problems will be delivered, via Moodle, 15 days before the problem sessions in dossier form. Students should try to solve them, independently, prior to the problem sessions, where they will be corrected.

## **Laboratory practices**

### **Biochemistry and Molecular Biology.**

A four-hour laboratory session will be held: Separation of proteins by gel filtration and by electrophoresis.

### **Cell Biology.**

There will be two two-hour sessions:

Introduction to the use of the optical microscope. Study of the plant cell.

Introduction to the use of the optical microscope. Study of the animal cell.

### **Warning on laboratory safety:**

The student who is involved in an incident that may have serious security consequences may be expelled from the laboratory and suspended.

## **Methodology**

The subject Fundamentals of Molecular and Cellular Biology consists of theoretical master classes using audiovisual media, practical classes in the laboratory and classes of problems.

The subject is divided into a first part focused on Biochemistry and Molecular Biology, and a second focusing on Cell Biology.

Theoretical master classes will be made using audiovisual material prepared by the teacher, material that the students will have at their disposal, in the Moodle of the UAB, before the sessions.

In problems classes, each theory group will be divided into two subgroups of about 30 students, the lists of which will be made public at the beginning of the course. Students will attend the sessions scheduled by their group. Problem classes are designed to work in small groups of students, with the objective to acquire group work and critical thinking skills.

In the part corresponding to Biochemistry and Molecular Biology, the methodology for the purification and characterization of proteins and problems of buffer systems and enzyme kinetics will be treated.

In the part of Cell Biology, the students, working in the same groups (formed in the part of Biochemistry and Molecular Biology), will have to solve in an autonomous way the problems that will later be corrected in the sessions of problems.

The practical classes are designed to learn the use of laboratory instruments and as a complement the theoretical training. The students will perform a total of 3 sessions of practices, the first of 4 hours and the second and third of two hours each .

## **Activities**

Title	Hours	ECTS	Learning outcomes
<b>Type: Directed</b>			
Problems lectures	8	0.32	1, 11, 8, 14, 17, 5, 20, 18
Theory lectures	36	1.44	9, 4, 6, 7, 11, 13, 16, 14, 10, 3, 17
<b>Type: Supervised</b>			
Laboratory practices	8	0.32	9, 11, 8, 14, 15, 20

Type: Autonomous

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Study	84	3.36	9, 14, 10, 20
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## Evaluation

To pass the subject requires the theory + problems + practices score, to be at least of 5 points out of 10 possible.

The planned evaluation activities are:

**Theory:** The theoretical part represents 70% of the final grade. To pass, the average of the 4 partial exams or the recovery one must be higher than 3.5.

First theoretical partial exam. It will represent 17.5% of the final score. The first half of the Molecular Biology part will be evaluated.

Second theoretical partial exam. It will represent 17.5% of the final score. The second half of the Molecular Biology part will be evaluated.

Third theoretical partial exam. It will represent 17.5% of the final score. The first half of the Cell Biology part will be evaluated.

Fourth theoretical partial exam. It will represent 17.5% of the final score. The second half of the Cell Biology part will be evaluated.

A theory recovery exam will be done to retrieve failed parts.

**Problems:** The problems part represents 20% of the final score.

1) Problems of the part of Molecular Biology. It will represent 10% of the final score. The problems of this part will be evaluated by an examination the day of the second partial of theory. There will be a recovery exam the same day of the theory recovery exam.

2) Problems on the part of Cell Biology. It will represent 10% of the final score. This part will be evaluated by an examination the day of the fourth partial of theory. There will be a recovery exam the same day of the theory recovery exam.

**Laboratory practices:** They will represent 10% of the final score. To qualify the practices the attitude of the student in the laboratory will be considered, as well as the correction of the questionnaires to be completed at the end of each practice. Attendance at laboratory practices is mandatory. The score of this part will be the average of the scores obtained in the practices of Cell Biology and in Biochemistry and Molecular Biology.

**Not evaluated:** Students who perform less than 50% of the evaluation activities described above will be considered as not evaluated.

## Evaluation activities

Title	Weighting	Hours	ECTS	Learning outcomes
1st Examination, corresponding to the first half of Biochemistry and Molecular Biology	17.5% of the global score	1	0.04	9, 4, 13, 14
2nd Examination, corresponding to the second half of Biochemistry and Molecular Biology	17.5% of the global score	1	0.04	6, 12
3rd Examination, corresponding to the first half of Cell Biology	17.5% of the	1	0.04	16, 14, 3

	global score			
4th Examination, corresponding to the second half of Cell Biology	17.5% of the global score	1	0.04	7, 16, 3, 19
Biochemistry and Molecular Biology Problems examination	10% of the global score	1	0.04	1, 14, 17, 5
Cell Biology Problems examination	10% of the global score	1	0.04	9, 11, 14, 10, 18
Laboratory practices	10% of the global score	8	0.32	2, 11, 8, 15, 20, 18

## Bibliography

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Mathews, Ch.K., van Holde, K.E. 2012 Biochemistry English 4ed.

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Nelson, D.L. and Cox, M.M. 2015. Lehninger-Principios de Bioquímica. 6a Ed. Omega.

Voet, D., Voet, J.G. and Pratt, C.H. 2006. Fundamentos de Bioquímica. 2a ed. Ed. Panamericana. Traducció de la 2<sup>a</sup> edició anglesa de l'any 2006.

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### ***Cell Biology***

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**Alberts B, Johnson A, Lewis J, Morgan D, Raff M, Roberts K, Walter P. 2015.** Molecular Biology of the cell. 6th Edition. Editorial Garland Science.

**Lodish H, Berk A, Kaiser CA, Krieger M, Bretscher A, Ploegh H, Amon A, Scott MP, . 2016.** Biología Celular y Molecular. 7<sup>a</sup> Edition. Editorial Panamericana.

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**Cooper GM, Hausman RE. 2017.** La Célula. Edición 2017. Marbán Libros S.L. Madrid.

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