UAB
Universitat Autònoma de Barcelona

Basic Molecular and Cell Biology

Code: 102493
ECTS Credits: 6

2024/2025

Degree	Type	Year
2502444 Chemistry	FB	1

Errata

Due to a restructuring in the distribution of teaching for the subject Molecular and Cellular Biology Foundations (102493), there has been a change in the responsible person. Instead of Dr Anna Genescà, the course 2024-25 coordinators are Dr Teresa Anglada Pons (teresa.anglada@uab.cat) and Dr Mireia Solé Canal (mireia.sole@uab.cat). Please contact them for any questions or issues regarding this subject.

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Teachers

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Teaching groups languages

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

Prerequisites

Although there are no prerequisites to attend it, it is recommended that the student have previous knowledge of:

1. Biomolecules and their functions
2. The structure and the basic functions of cell organelles

Moreover, taking into account that most up-to-date sources of information in the field of Molecular and Cell Biology are in English, it is highly recommended that the students who study this subject have a basic knowledge of this language.

Objectives and Contextualisation

The subject Fundamentals of Molecular and Cell Biology, is a subject of the 1st semester of the 1st year of the Chemistry Degree .

Objectives of the subject:

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 explain the cell structure and ultrastructure.

5) To describe the functions of cell organelles and other cellular structures and to understand that their coordinated functioning is essential for the cell tasks' development .

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

Competences

- "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 one's 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 one's 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

THEORETICAL LESSONS

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 α-helix and β-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. Lipids: 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.

Unit 10. Cytosol. Intracellular compartments. Intracellular protein trafficking.

Unit 11. Nucleus. Structure and nucleus-cytoplasm transport.

Unit 12: 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 13: Mitochondria. Structure and functions.

Unit 14: Cytoskeletal elements. Role in cell functioning and tissue maintenance. Actin microfilaments, structure and function. Microtubules, structure and function. Intermediate filaments, structure and function. Cell junctions.

Unit 15. Cell Cycle. Cell cycle and its control. Mitotic and meiotic cell division.

CLASSROOM PRACTICES - 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 list of problems will be available through the *Moodle* classroom of the Virtual Campus before the sessions. Students should try to solve them, autonomously, 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 gelfiltration and by electrophoresis.

CELL BIOLOGY

There will be two sessions of two hours each:

· 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 LAB SAFETY: If a student is involved in an incident that may have serious security consequences may be expelled from the laboratory and may not pass this subject.

Activities and Methodology

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Classroom practices	8	0.32	1, 2, 8, 14, 17, 18, 19, 20
Laboratory practices	8	0.32	7, 8, 11, 14, 15, 20
Theoretical classes	36	1.44	2, 3, 4, 6, 7, 9, 10, 11, 13, 14, 16, 17
Type: Autonomous			

Individual study	78.5	3.14	3, 4, 6, 7, 9, 10, 11, 13, 14, 16, 19
Problems resolution	12	0.48	1, 2, 5, 8, 9, 10, 11, 14, 17, 18, 19, 20

The subject of Fundamentals of Molecular and Cellular Biology consists of Theoretical classes, Classroom Practice classes, and Laboratory Practice classes. The teaching methodology that will be followed in these training activities is described below:

THEORETICAL LESSONS

The basic theoretical knowledge of the Biochemistry and Molecular Biology block will be taught in 18 face-to-face hours and those of the Cell Biology block in a further 18 hours.

The theoretical lectures will be accompanied by visual support material in power point format prepared by the teaching staff. This support material will be available to students in the Moodle classroom of the Virtual Campus of this subject so that it can be downloaded and used as a basis for taking notes during classes. In some topics, videos or animations will also be projected to facilitate the understanding of certain processes.

NOTE: 15 minutes of a class will be reserved, within the calendar established by the centre/degree, so that students can answer the surveys for the evaluation of the teaching performance of the teaching staff and the evaluation of the subject.

CLASSROOM PRACTICES - PROBLEMS

In the practical classroom classes, experimental problems related to the contents of the theory classes will be solved. Students will have 6 sessions of Biochemistry and Molecular Biology problems and 2 sessions of Cell Biology.

The classroom practice classes are designed for students to work in small groups, and acquire group work and critical reasoning 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 enzymatic kinetics will be discussed.

In the Cell Biology part, students will have to solve, prior to each session, problems related to theory topics, delving into the molecular components and mechanisms responsible for the functions of the eukaryotic cell. These problems will later be corrected in the problem sessions.

PRACTICES IN THE LABORATORY

The practical classes in the laboratory are designed for students to learn to use laboratory instruments and complement their theoretical training. Students will carry out a total of 3 practice sessions. In the first practice, the separation of proteins by gel filtration and by electrophoresis in SDS will have a total duration of 4 hours. The other two practices, Introduction to the use of the optical microscope: Study of the plant cell and Introduction to the use of the optical microscope: Study of the animal cell, will last 2 hours each.

ATTENTION: In order to attend the laboratory practices, students must justify having passed the biosafety and safety tests that they will find on the Virtual Campus and be aware of and accept the operating rules of the laboratories of the Faculty of Sciences and the Faculty of Biosciences.

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
1st Partial Examination (Theoretical content and Problems). Biochemistry and Molecular Biology contents	45% of the global score	3	0.12	1, 2, 5, 6, 9, 10, 11, 13, 14, 17, 18
2nd Partial Examination. Cell Biology contents	35% of the global score	2.5	0.1	2, 3, 4, 7, 9, 14, 16, 19
Cell Biology Problems examination	10% of the global score	0.5	0.02	5, 9, 10, 11, 14, 18
Laboratory practices	10% of the global score	1.5	0.06	2, 8, 11, 12, 15, 18, 20

EVALUATION

To pass the subject, the final weighted average grade of theory, problems and practices equals or exceeds 5 points out of 10 possible.

ATTENTION: Attendance at laboratory practices is mandatory. Failure to attend laboratory practices without justification will imply that students can NOT pass the subject.

1- CONTINUOUS ASSESSMENT

The programmed continuous assessment activities are:

1.1- THEORETICAL LESSONS and PROBLEMS

First midterm exam: The theoretical contents + problems of Molecular Biology of the subject will be evaluated and the grade obtained in this midterm will represent 45% of the final grade. The exam may include multiple-choice questions, short-answer questions and problems.

Second midterm exam: The theoretical contents + problems of Cell Biology of the subject will be evaluated and the grade obtained in this partial will represent 45% of the final grade (35% theory contents + 10% problems). The exam may include multiple-choice questions and/or short-answer theory and problem questions.

- For the 2 midterm exams to average, the minimum grade of the Cell Biology exam must be greater than or equal to 3.5. If students obtain a grade lower than 3.5 in this midterm, they must take the retake exam. There is no minimum grade for the midterm exam of Biochemistry and Molecular Biology to average the grade of the Cell Biology part.

Theory + problems recovery exam: This exam will serve to retake the necessary midterm exams.

- To be able to access the retake, students must have been evaluated in a set of activities whose weight is equivalent to a minimum of two-thirds of the total evaluation activities of the subject.
- For the theoretical part + problems of the subject to be averaged with the laboratory practice part, the average of the 2 midterm exams or retake the exam(s) must be equal to or greater than 3.5.

1.2 - LABORATORY PRACTICES

Laboratory practices represent 10% of the final grade of the subject and will be evaluated as described below.

Biochemistry and Molecular Biology Internships: They will represent 5% of the subject's final grade. To grade the practices, the attitude of the students in the laboratory will be taken into account, as well as the assessment of the questionnaires that they will have to complete at the end of the practice.

Cell Biology Internships: They will represent 5% of the subject's final grade. The practice grade will be obtained from the arithmetic average of the short questionnaires that will be carried out at the end of each practice.

Summary table of the weight of each of the parts:

BM Internship	5%
BC Internship	5%
Theory and BM problems	45%
BC Theory and Problems	45% (35% TE + 10% problems)

1.3- OTHER CONSIDERATIONS

- NOT ASSESSED: Students who, not having adhered to the single assessment, carry out less than 50% of the assessment activities described above will be considered as not assessed.
- Continuous assessment students who do not pass the theoretical part + problems of the subject, but pass the practical part (obtaining a minimum of 5 points out of 10), can request that the practical grade be kept for a period of three additional enrolments (but they will have to enrol again for ALL the subject).
- Students who pass the Cell Biology block (obtaining a minimum of 5 points out of 10 including theory, laboratory practices and problems), but fail the Molecular Biology block can request that the grade of the approved block be kept for a period of three additional enrollments (but they will have to enrol again in ALL the subject). The grade of the Molecular Biology part of one course is not kept for the next.
- Under no circumstances will the problem score be saved if the complete block has not been passed.
- Students who are unable to attend an individual assessment test for a justified reason (such as a health problem, death of a relative up to the second degree, accident, elite athlete status and having a competition or sports activity that is mandatory, etc.) and provide the corresponding officialdocumentation to the teaching staff and the coordination of the degree (official medical certificate explicitly stating the inability to take an exam, police report, justification from the competent sports body, etc.), will have the right to take the test on another date. The coordination of the degree will ensure that this test is carried out, after consultation with the teaching staff of the subject.
- Students who have passed the theory, problems and practices may also take the retake exam to IMPROVE GRADE, and theory and problems will be examined. To be able to sit, you must renounce in writing (email) the grade obtained, notifying the teaching staff responsible for the subject at least three days before the retake exam. The grade that will be taken into account will be that of the last exam that the students have taken.

2- SINGLE ASSESSMENT

Students who opt for a single assessment must request it within the deadline and in the manner indicated by the Faculty.

2.1-THEORY AND PROBLEMS

This part represents 90% of the final grade of the subject, and will be evaluated by:

Single exam of theory and problems: The single evaluation of the theory and problems will consist of an exam that will be held on the day of the second partial of the subject and that will consist of multiple-choice questions and/or short questions or exercises referring to all the contents of theory and problems of Biochemistry and Molecular Biology and the contents of theory and problems of Cell Biology.

Theory and problem retake exam: The retake of the single assessment will be on the same day and time as the continuous assessment retake test.

2.2- PRACTICES IN THE LABORATORY

ATTENTION: Students who take the single assessment must carry out the practices of this subject in face-to-face sessions with the rest of their classmates. At the end of each practice session, students will take the corresponding practice evaluation questionnaire. Attendance at the practices is MANDATORY and ESSENTIAL to be able to take the single theory and problems exam.

Laboratory practices represent 10% of the final grade of the subject and will be evaluated by:

Biochemistry and Molecular Biology Internships: They will represent 5% of the subject's final grade. To grade the practices, the attitude of the students in the laboratory will be taken into account, as well as the assessment of the questionnaires that they will have to complete at the end of the practice.

Cell Biology Internships: They will represent 5% of the subject's final grade. The practice grade will be obtained from the arithmetic average of the short questionnaires that will be carried out at the end of each practice.

2.3- OTHER CONSIDERATIONS

- Single assessment students who do not pass the theoretical part + problems of the subject, but pass the practical part (obtaining a minimum of 5 points out of 10), may request that this practical grade be kept for a period of three additional enrolments (but they will have to re-enrol for the ENTIRE subject).
- Single-assessment students who pass the Cell Biology block (obtaining a minimum of 5 points out of 10 including theory, laboratory practices and problems), but fail the Molecular Biology block, may request that the grade of the approved block be kept fora period of three additional enrolments (but they will have to re-enrol in ALL the subject). The grade of the Molecular Biology part of one course is not kept for the next.
- Under no circumstances will the problem score be kept.
- Single assessment students who cannot attend the individual assessment tests for a justified reason (such as a health problem, death of a family member up to the second degree, accident, elite athlete status and having a competition or sports activity that is mandatory, etc.) and provide the corresponding official documentation You will have the right to take the test on another date. The coordination of the degree will ensure that this test is carried out, after consultation with the teaching staff of the subject.
- Students who have passed the theory, problems and practices may also take the retake exam to IMPROVE GRADE, and theory and problems will be examined. To be able to sit, you must renounce in writing (email) the grade obtained, notifying the teaching staff responsible for the subject at least three days before the retake exam. The grade that will be taken into account will be that of the last exam that the students have taken.

Bibliography

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Cooper: http://www.ncbi.nlm.nih.gov/bookshelf/br.fcgi?book=cooper

Alberts:http://www.ncbi.nlm.nih.gov/bookshelf/br.fcgi?book=mboc4

Software

No specific software will be used

Language list

Name	Group	Language	Semester	Turn
(PAUL) Classroom practices	1	Catalan/Spanish	first semester	morning-mixed
(PAUL) Classroom practices	2	Catalan/Spanish	first semester	morning-mixed

(PAUL) Classroom practices	3	Catalan/Spanish	first semester	afternoon
(PAUL) Classroom practices	4	Catalan/Spanish	first semester	afternoon
(PLAB) Practical laboratories	1	Catalan/Spanish	first semester	afternoon
(PLAB) Practical laboratories	2	Catalan/Spanish	first semester	afternoon
(PLAB) Practical laboratories	3	Catalan/Spanish	first semester	afternoon
(PLAB) Practical laboratories	4	Catalan/Spanish	first semester	morning-mixed
(PLAB) Practical laboratories	5	Catalan/Spanish	first semester	morning-mixed
(PLAB) Practical laboratories	6	Catalan/Spanish	first semester	morning-mixed
(TE) Theory	1	Catalan/Spanish	first semester	morning-mixed
(TE) Theory	2	Catalan/Spanish	first semester	afternoon