UAB
Universitat Autònoma de Barcelona

Molecular Cell Biology

Code: 101898
ECTS Credits: 6

2025/2026

Degree	Type	Year
Biomedical Sciences	OB	2

Contact

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Teachers

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Teaching groups languages

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

Prerequisites

It is recommended that the student has successfully completed the subjects of *Structure and Function of Biomolecules*, *Metabolism of Biomolecules* and *Cell Biology*. In addition, it is advisable for students to have a good knowledge of English because many of the sources of information on this subject are written in this language

Objectives and Contextualisation

The subject of Cell Molecular Biology has a basic character in the degree and with it, it is intended that the student acquires solid knowledge on the molecular basis of the eukaryotic cellular structures. These biological knowledge is complemented with those of other basic and compulsory subjects of the syllabus, such as *Cell Biology*, *Structure and Function of Biomolecules*, *Metabolism of Biomolecules*, *Genetics* or *Immunology* that, as a whole, will provide to the Biomedical Science students a good understanding of the structural and functional organization of living organisms. On the other hand, the theoretical knowledge acquired in the subject of *Molecular Biology of the Cell* is complemented by a practical training in the laboratory in the subject of *Laboratory 2*.

The training objectives are that the student, at the end of the subject, is able to:

- Identify the main mechanisms of chromatin structure regulation and gene expression
- Describe the basic signaling strategies involved in cell communication
- Describe the proteins involved in the regulation of cell cycle progression, differentiation, specialization and cell death

- To recognize the cellular bases of cancer and its medical application in cancer therapies
- Describe the mechanisms of signal transduction and cellular responses based on the recognition of extracellular matrix elements for integration of cells into tissues.
- To explain the properties of stem cells and tissue maintenance and their involvement in cell engineering and their therapeutic potential

Competences

- Act with ethical responsibility and respect for fundamental rights and duties, diversity and democratic values.
- Display knowledge of the basic life processes on several levels of organisation: molecular, cellular, tissues, organs, individual and populations.
- Display theoretical and practical knowledge of the major molecular and cellular bases of human and animal pathologies.
- Make changes to methods and processes in the area of knowledge in order to provide innovative responses to society's needs and demands.
- Read and critically analyse original and review papers on biomedical issues and assess and choose the appropriate methodological descriptions for biomedical laboratory research work.
- Students must be capable of applying their knowledge to their work or vocation in a professional way and they should have building arguments and problem resolution skills within their area of study.
- Students must be capable of collecting and interpreting relevant data (usually within their area of study) in order to make statements that reflect social, scientific or ethical relevant issues.
- Students must be capable of communicating information, ideas, problems and solutions to both specialised and non-specialised audiences.
- Students must develop the necessary learning skills to undertake further training with a high degree of autonomy.
- Students must have and understand knowledge of an area of study built on the basis of general secondary education, and while it relies on some advanced textbooks it also includes some aspects coming from the forefront of its field of study.
- Take account of social, economic and environmental impacts when operating within one's own area of knowledge.
- Work as part of a group with members of other professions, understanding their viewpoint and establishing a constructive collaboration.

Learning Outcomes

1. Act with ethical responsibility and respect for fundamental rights and duties, diversity and democratic values.
2. Analyse the molecular mechanisms of compartmented intracellular transport by means of molecular motors and of their extrapolation to cell and tissue motility.
3. Analyse the molecular mechanisms that regulate the size and differentiation stage of cells in tissues.
4. Describe the mechanisms of cell signalling and communication.
5. Describe the molecular components of the extracellular matrix, their adhesion strategies, and the mechanisms that regulate this adhesion.
6. Discern functional heterogeneity in a tissue and in some experimental methods for observing them.
7. Explain the regulation of the cell cycle and its modulation.
8. Identify the mechanisms that regulate gene expression in cells, and their importance in the different cell functions.
9. Identify the molecular principles that are common to the selective transport of substances through the plasma membrane and their regulation.
10. Make changes to methods and processes in the area of knowledge in order to provide innovative responses to society's needs and demands.
11. Students must be capable of applying their knowledge to their work or vocation in a professional way and they should have building arguments and problem resolution skills within their area of study.

12. Students must be capable of collecting and interpreting relevant data (usually within their area of study) in order to make statements that reflect social, scientific or ethical relevant issues.
13. Students must be capable of communicating information, ideas, problems and solutions to both specialised and non-specialised audiences.
14. Students must develop the necessary learning skills to undertake further training with a high degree of autonomy.
15. Students must have and understand knowledge of an area of study built on the basis of general secondary education, and while it relies on some advanced textbooks it also includes some aspects coming from the forefront of its field of study.
16. Take account of social, economic and environmental impacts when operating within one's own area of knowledge.
17. Understand the adjustments necessary in tissue bioenergetics according to energy demand.
18. Work as part of a group with members of other professions, understanding their viewpoint and establishing a constructive collaboration.
19. Write a review paper in the area of molecular and cell biology.

Content

Topic 1. Cell Matrix and integration of cells in tissues. General aspects of the Extracellular Matrix. Extracellular Matrix Elements: Collagen, Fibronectin, Laminin, Proteoglycans (structure and type). Plasma membrane proteins involved in cell adhesion: Families. General characteristics. Family of the Cadherins. Catenins. Integrin family. Adhesion regulation and adhesion kinases. Immunoglobulin Superfamily. N-CAM subfamily and development. Cell adhesion molecules in T cells. Selectin family. Function in leukocyte migration.

Topic 2. Cell Signaling: Signaling Strategies. Intercellular signals: hormones and receptors, signal transduction and cellular responses based on the recognition of extracellular matrix elements. Cell adhesion and signal transduction: role of cadherins and integrins Membrane proteoglycans: regulation in the adhesion of growth factors and participation in signal transduction. Signaling linked to intracellular receptors. Transduction of signals by plasma membrane receptors. G protein-related receptors. The WNT pathway. Catalytic receptors: activation of enzymatic cascades. Interaction and regulation of signal pathways. Transmission of signals from the cell surface to the nucleus: phosphorylation of target proteins. Medical applications of signal study and cellular communication. The Notch pathway.

Topic 3. Control of the cell cycle. General principles of the cell cycle. Proteins involved in the regulation of cycle progression. Checkpoints during the cell cycle: proteins and mechanisms involved. Control of the cell cycle by the action of miRNAs. Regulation of miRNA transcription: role of p53 as a regulator. Apoptosis. Types of apoptotic pathways: intrinsic or mitochondrial-dependent and extrinsic. Apoptosis mechanism: cascades of intracellular proteolysis. Role of caspases and IAP and Bcl-2 proteins. Cellular aging.

Topic 4. Cell bases of cancer. Clonalorigin of the cancer cell and tumor progression. Conductive mutations vs. transient mutations. Acquired capabilities of the cancer cell and their effects on: 1) the mechanisms of cell cycle control, 2) Invasion and metastasis: role of adhesion molecules (selectins), 3) Immortality, 4) Induction of angiogenesis and 5) Tumor progression. Genomic instability and mutations. Exosomes and cancer. miRNAs and cancer. Medical applications of the study of the above mechanisms: anti-cancer therapies.

Topic 5. Stem cells. Definition. Transient amplifier cells. Potential and stem cell types. Stem cells in tissues. Studies in different tissues: Human epidermis. Hair follicle and sebaceous gland. Small intestine. Olfactory epithelium and olfactory neurons. Hair cells in the ear. Bone marrow. Muscle tissue. Adipose tissue. Nerve tissue. Membership regeneration. Stem cell generation and therapeutic potential.

Topic 6 . Chromatin remodeling. Definition of epigenetics. Role of chromatin in the eukaryotic gene expression. Methylation of DNA. Methods for the detection of methylated DNA regions. Modification of histones and complex chromatin modifiers. Interaction between histone modifications, methylation of DNA. Regulatory RNAs. Histone variants. Remodeling complexes of SWI-SNF chromatin and NURF. Chromatin during replication and transcription. Test of hypersensitivity to DNase I.

Topic 7. Transcriptional regulation: Common features and differences between the transcription mediated by the three eukaryotic polymerases. Review of the characteristics of the promoter zone of DNA polymerase II. Footprint test. Activators and silencers "enhancers and silencers". Identification of gene regulatory areas. Basal transcription complex and specific transcription factors. The Mediator and SAGA complexes. Co-activators. Regulationof the transcription of RNA polymerase II. Characteristics of transcriptionfactors. Activation domains. Regulation of the activity of the transcription factors. Methods of identification and purification of transcription factors. Methods of identification of DNA regions to which transcription factors are attached. Verification of the functionality of the pair transcription factor / regulatory sequence in vivo.

Topic 8. Post-transcriptional regulation: The mRNA edition, the role of the mRNA hood (CAP 5 ') in the translation of mRNA and its stability. The union complex in CAP (CBC) and eIF4E. Polyadenylation and its role in the translation and stability of mRNA. The histone mRNAs. Spliceosome, SR proteins and "exo-splicing-enhancers" (ESEs). Alternative splicing and trans-splicing. Regulation of alternative splicing. Coupling between RNA processing and transcription. Methods for identifying variants of alternative splicing. Editing mRNA. Regulation of the transport of mRNA. Control of the average life of mRNA and quality control. P-bodies and stress granules. Regulation elements in mRNA and regulatory proteins. Methods for determining the average life of mRNA. Regulation of translation. Post-transcriptional regulation through sRNAs (siRNA and miRNA). Regulation of the average life of proteins.

Activities and Methodology

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Theory and seminar sessions	40	1.6	17, 5, 4, 2, 6, 7, 3, 8, 9
Type: Supervised			
Learning based on preparation and presentation of a scientific communication in a simulated congress environment	8	0.32	1, 16, 17, 19, 3, 8, 9, 10, 18
Type: Autonomous			
Study, and research of information.	54	2.16	17, 5, 4, 2, 6, 19, 7, 3, 8, 9, 18

The training activities are divided into two sections: theory sessions and seminar sessions, each of them with their specific methodology.

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

Assignments	20%	8	0.32	1, 16, 5, 4, 6, 19, 7, 3, 8, 10, 15, 14, 13, 11, 12, 18
First partial exam	60%	24	0.96	1, 16, 5, 4, 7, 3, 9, 14, 13, 11, 12
Second partial exam	40%	16	0.64	1, 16, 17, 2, 6, 8, 14, 13, 11, 12

CONTINUOUS ASSESSMENT

Theory

The total weight of the evaluation of the theoretical part will be 80% of the total grade of the subject. The main evaluation of this part of the subject will have the format of continuous evaluation with two partial tests. The weighted weight of the first partial is 60%; The weighted weight of the second partial is 40%. The partial exams must be passed with a minimum of 5.0 points out of 10. In case less than 5.0 has been obtained, the suspended partial (s) can be recovered in the recovery exam.

The evaluation of the theory can be recovered as indicated at the end of this section.

Scientific seminars

Students will work in small groups outside school hours with the aim of preparing two seminars focused on the relationship between molecular processes addressed in the subject and the development of cellular dysfunctions that lead to diseases. The content must be based on rigorous and contrasted scientific information and must be presented in slide format. Each group will present its work on the established dates, in a simulated context of a scientific congress. This environment will promote peer debate and the formulation of questions by the audience, with the aim of promoting critical thinking and the consolidation of the knowledge presented. The evaluation of the activity will be carried out through a rubric previously agreed with the students. A peer evaluation is contemplated, in which the students themselves will evaluate the presentations of their classmates. This peer evaluation will represent 30% of the final grade of the seminar activity.

Use of AI. In this activity, the use of artificial intelligence (AI) technologies is authorized, provided that they are used as a support tool in tasks such as searching for information, linguistic correction or translating texts. In no case, however, can AI replace the reflection, critical analysis or synthesis capacity required for this activity. Students will have to clearly and explicitly identify which parts of the work have been developed with the support of AI tools, specify which ones have been used and include a brief critical reflection on how these tools have contributed to the process and the result. The lack of transparency in the use of AI will be considered a lack of academic honesty and may lead to penalties in the qualification of the activity, or more serious sanctions in the event of a serious infraction.

Global assessment

The subject will be passed when the sum of the different parts, weighted by their specific weight in the subject, equals or exceeds 5.0 out of 10 points. Each of the partials must pass with a minimum of 5.0 points out of 10 to be able to add the seminar grade to the overall grade.

To participate in the theory recovery, according to UAB regulations, 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 or module. Therefore, students will obtain the "Non-Valuable" qualification when the evaluation activities carried out have a weighting of less than 67% in the final grade.

Students who have had to recover the subject in the recovery test will not be able to opt for the maximum grade of honor enrollment, but may opt for a maximum of excellent.

Students who cannot attend an individual assessment test for justified cause (such as illness, death of a first-degree relative or accident ... etc) and provide the corresponding official documentation to the course coordinator will have the right to take a recovery test, which could be oral.

EXAMINATION-BASED ASSESSMENT

The single assessment examination consists of a written examination with development questions and/or short questions related to the eight theory topics. The seminar activity will be evaluated based on two exercises (video) that must be delivered through the CV

Single assessment consists of a single examination in which the contents of the entire theory programme (the eight topics) will be assessed. The test will consist of development questions and/or short questions. The mark obtained in this synthesis test will represent 80% of the final grade of the subject. The single assessment examination will coincide with the same date set in the calendar for the second partial of continuous assessment and the same recovery system will be applied as for continuous assessment.

The evaluation of seminar activities (not compulsory attendance for students who adhere to the single assessment format) will follow the same process as continuous assessment: students will submit two exercises (audiovisual files) through the virtual campus, on the date on which the people involved will be informed at the beginning of the course. The grade obtained will represent 20% of the final grade of the subject.

The subject will be passed when the exam grade exceeds 5.0 out of 10 points. This note will also be the minimum so that the seminar grade can be considered

Bibliography

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- La Célula. Cooper GM i Hausman RE. 6ª Edició Ed Marbán, 2014

- Cellular signal processing. Marks F, Klingmüller U, Müller-Decker K. Garland Science, 2nd Edition, 2017

- Molecular Biology of assemblies and Machines. Steven AC, Baumeister W, Johnson LN, Perham RH. Garland Science, 2016

- Gene Control. Latchman DS, 2nd Ed. Garland Science, 2020 (ebook a la biblioteca).

- Epigenetics. Allis, C.D. et al., 2n Ed. CSH press, 2015.

- Lehninger. Principles of Biochemistry. Nelson, D. and Cox, M., 8th ed. W.H. Freeman (Macmillan Learning), 2021.

- Molecular biology, Zlatanova, J, 2n Ed. Garland Science, 2023.

- Journal of visualized Experiments (JOVE)-Science Education Collection.

Review articles and weblinks available at "Campus Virtual".

Software

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
(SEM) Seminars	521	Catalan	first semester	morning-mixed
(SEM) Seminars	522	Catalan	first semester	morning-mixed
(TE) Theory	52	Catalan	first semester	morning-mixed