Universitat Autònoma de Barcelona

2021/2022

Molecular Cell Biology

Code: 101898
ECTS Credits: 6

Degree	Type	Year	Semester
2501230 Biomedical Sciences	OB	2	1

The proposed teaching and assessment methodology that appear in the guide may be subject to changes as a result of the restrictions to face-to-face class attendance imposed by the health authorities.

Contact

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Use of Languages

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

Other comments on languages

66% Catalan and 33% Spanish

Teachers

Maria Oliver Bonet

Prerequisites

It is recommended that the student has successfully completed the subjects of "Structure and Function of Biomolecules", "Metabolism of Biomolecules" and "Cell Biology."

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 has 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 are complemented by a practical training in the laboratory in the subject of Laboratory 2.

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

*Syllabus:

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. Clonal origin 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 transcription factors. 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.

* Unless the restrictions imposed by the health authorities require a prioritization or reduction of such content.

Methodology

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

**The proposed teaching methodology may experience some modifications depending on the restrictions to face-to-face activities enforced by health authorities.*

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.

Activities

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Theory and seminar sessions	36	1.44	17, 5, 4, 2, 6, 7, 3, 8, 9
Type: Supervised			
Problem based learning	12	0.48	17, 19, 3, 8, 9, 18
Type: Autonomous			
Study, and research of information.	82	3.28	17, 5, 4, 2, 6, 19, 7, 3, 8, 9, 18

Assessment

*Assessment:

Midterm exams:

The total weight of the two midterm exams will be 70%. The minimum score should be 5.0 points (out of 10). If the minimum were not reached, the student would have a second chance at the end of the course.

Seminars:

The weight of the seminar evaluation will be 30% of the total. Assignments will be individual, and their attendance is mandatory (with few justified exceptions). They will be delivered through the delivery tool of the "Campus Virtual". The use of English will be scored for non-native speakers (up to 10% of the total mark).

There is not second-chance examination for seminars.

Additional issues:

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. The mid-term exams must be overcome with a minimum of 5.0 points in order to be eligible to add the 30% of assignment marks.

In order to be eligible for performing the second-chance examination, according to UAB regulations, students must have done a set of activities, the weight of which equals a minimum of two-thirds of the total mark in the

subject. Therefore, the students will get a "Not assessable" qualification when the sum of activities carried out have a weight lower than 67% of the total.

Those students who apply to the second-chance examination will not be eligible for the maximum grade of honour.

Those students who couldn't attend to an exam for a justified reason (such as illness, the death of a first-degree relative, an accident ... etc), and provide the corresponding prove to the degree-coordinator, will have the opportunity to perform his/her assessment in a different date.

**Student's assessment may experience some modifications depending on the restrictions to face-to-face activities enforced by healthauthorities.*

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Assignments	30%	12	0.48	1, 16, 17, 5, 4, 2, 6, 19, 7, 3, 8, 9, 10, 15, 14, 13, 12, 18
Midterm exams	70%	8	0.32	1, 16, 17, 5, 4, 2, 6, 19, 7, 3, 8, 9, 14, 13, 11, 12, 18

Bibliography

- Biologia molecular de la Célula. Alberts B, Johnson A, Lewis J, Morgan D, Raff M, Robert K, Walter P. 6ª edició Ediciones Omega S.A. 2016. Versió original en anglès d'aquesta edició: Molecular Biology of the Cell. 6th ed. Ed Garlan Science, 2015

- Functional Biochemistry in Health and Disease. E Newsholme and T Leech. Ed. Wiley-Blackwell, 2nd Edition, 2011

- 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, 2015 (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.

- Biochemistry. Voet D and Voet JG. 4th ed. John Wiley & Sons Ltd, 2011 -Fundamentos de Bioquímica: La vida a nivel molecular 4a ed. Editorial Medica Panamericana, 2016.

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

Review articles and weblinks available at "Campus Virtual".

Software

Hyper Cell (Electronic Companion to Molecular Biology of the Cell (Alberts et al.)