Universitat Autònoma de Barcelona

**2019/2020**

# Molecular Cell Biology

Code: 101898
ECTS Credits: 6

| Degree | Type | Year | Semester |
|---|---|---|---|
| 2501230 Biomedical Sciences | OB | 2 | 1 |

## Contact

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## Use of Languages

Principal working language: spanish (spa)
Some groups entirely in English: No
Some groups entirely in Catalan: No
Some groups entirely in Spanish: No

## Other comments on languages

70% Catalan and 30% Spanish

## Teachers

Jordi Benet Català
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

- Contribute to public discussions on cultural matters.
- Develop critical thinking and reasoning and communicate ideas effectively, both in the mother tongue and in other languages.
- Develop independent learning habits and motivation to continue training at postgraduate level.
- Develop independent learning strategies.

- Develop scientific knowledge, critical reasoning and creativity.
- 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.
- Generate innovative and competitive proposals for research and professional activities.
- Identify and understand the advances and challenges of research.
- Read and critically analyse original and review papers on biomedical issues and assess and choose the appropriate methodological descriptions for biomedical laboratory research work.
- Work as part of a group with members of other professions, understanding their viewpoint and establishing a constructive collaboration.

## Learning Outcomes

1. Analyse the molecular mechanisms of compartmented intracellular transport by means of molecular motors and of their extrapolation to cell and tissue motility.
2. Analyse the molecular mechanisms that regulate the size and differentiation stage of cells in tissues.
3. Contribute to public discussions on cultural matters.
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. Develop critical thinking and reasoning and communicate ideas effectively, both in the mother tongue and in other languages.
7. Develop independent learning habits and motivation to continue training at postgraduate level.
8. Develop independent learning strategies.
9. Develop scientific knowledge, critical reasoning and creativity.
10. Discern functional heterogeneity in a tissue and in some experimental methods for observing them.
11. Explain the regulation of the cell cycle and its modulation.
12. Generate innovative and competitive proposals for research and professional activities.
13. Identify and understand the advances and challenges of research.
14. Identify the mechanisms that regulate gene expression in cells, and their importance in the different cell functions.
15. Identify the molecular principles that are common to the selective transport of substances through the plasma membrane and their regulation.
16. Understand the adjustments necessary in tissue bioenergetics according to energy demand.
17. Work as part of a group with members of other professions, understanding their viewpoint and establishing a constructive collaboration.
18. Write a review paper in the area of molecular and cell biology.

## Content

Topic 1. 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 2. Transcriptional regulation: common Aspects 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. Regulation of 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 3. 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. Splicesosome, 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-bodiesand 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.

Topic 4. Cell Signaling: Signaling Strategies. Intercellular signals: hormones and receptors. Signaling linked to intracellular receptors. Signal transduction for plasma membrane receptors. Receptors related to G. proteins. The Wnt path. 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 the study of signals and cellular communication. The Notch pathway.

Topic 5. Control of the cell cycle: General principles of the cell cycle. Proteins involved in regulating the progression of the cycle. Control points during the cell cycle: proteins and mechanisms involved. Control of the cell cycle by action of miRNAs. Regulation of the transcription of miRNA: role of p53 as a regulator. Apoptosis. Types of apoptotic routes: intrinsic or dependent on mitochondria and extrinsic. Apoptotic mechanism: intracellular proteolysis cascades. Role of caspases and proteins IAP and Bcl-2. Cellular aging.

Topic 6. Cellular cancer bases. Clonal origin of the cancerous cell and tumor progression. Conductive mutations vs. passenger mutations. Acquired capabilities of the cancer cell and its effects on: 1) cell cycle control mechanisms, 2) Invasion and metastasis, 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 previous mechanisms: therapies against cancer.

Topic 7.Integration of cells in tissues. Cell adhesion and signal transduction. Protein membrane plasmatic implicated in cell adhesion: Families. General characteristics. Family of the Cadherins. Signal transduction and cellular responses. Family of the Integrins. Regulation of adhesion and adhesion kinases. Signs via integrins. Signal transduction and cellular responses. Superfamily of the Immunoglobulins. Subfamilia N-CAM and development. Cell adhesion molecules in T. cells Family of the Selectins. Function in the migration of leukocytes. Relationship with metastasis. Proteoglycans. Structure and type. Proteoglycans membrane: regulation in the adhesion of growth factors and participation in signal transduction. Elements of Extracellular Matrix: Collagen. Fibronectin. Laminin Transcription of cell signals and responses based on the recognition of extracellular matrix elements.

Topic 8. Stem cells: Definition. Transient amplifier cells. Potentiality and types of stem cells. Stem cells in tissues. Studies in different tissues: Human epidermis. Follicle hair and sebaceous gland. Small intestine. Olfactory epithelium and olfactory neurons. Ciliated ear cells. Bone marrow. Muscle tissue. Adipose tissue. Nerve tissue. Regeneration of members. Generation of stem cells and therapeutic potential.

## Methodology

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

## Activities

| Title | Hours | ECTS | Learning Outcomes |
|---|---|---|---|
| Type: Directed | | | |
| Theory and seminar sessions | 36 | 1.44 | 16, 3, 5, 4, 1, 9, 10, 11, 12, 2, 14, 15, 13 |
| Type: Supervised | | | |

| | | | |
|---|---|---|---|
| Problem based learning | 12 | 0.48 | 16, 3, 9, 7, 6, 18, 12, 2, 14, 15, 13, 17 |
| Type: Autonomous | | | |
| Study, and research of information. | 82 | 3.28 | 16, 3, 5, 4, 1, 9, 8, 7, 6, 10, 18, 11, 12, 2, 14, 15, 13, 17 |

## Assessment

Theory:

The total weight of the evaluation of the theoretical part will be 70% of the total mark of the subject. The main evaluation of this part of the subject will have the format of continuous evaluation with a mid-course exam. Each exam must be overcome with a minimum of 5.0 points out of 10. In case someone obtains less than 5.0, he or she will be able to reassess it in the final exam.

Seminars:

Seminars will have continuous evaluation. The weight of the seminar evaluation will be 30% of the total. Assignments must be individual, and their attendance is mandatory (except in justified circumstances). They will be delivered through the delivery tool of the "Campus Virtual". The use of English will be scored, corresponding to 10% of the work note.

Seminars will not be reassessed.

Overall evaluation:

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 exam must be overcome with a minimum of 5.0 points out of 10 in order to add the note of the assignments to the overall score.

To participate in the final exam, according to UAB regulations, students must have been previously evaluated in a set of activities the weight of which equals a minimum of two thirds of the total grade of the subject. Therefore, the students will obtain the "Not Evaluable" qualification when the evaluation activities carried out have a weight lower than 67% in the final grade.

Students who must do the final exam will not be eligible for the maximum grade of honor, but may opt at most to the excellent.

Students who cannot attend an individual exam for a justified reason (such as illness, death of a first-degree relative, by accident ... etc), and provide the corresponding official documentation to the Degree Coordinator, can do the exam in a later date.

## Assessment Activities

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

## Bibliography

- Biochemistry. Voet D and Voet JG. 4th ed. John Wiley & Sons Ltd, 2010

-Molecular Cell Biology. 7th Edition. WH Freeman and Company, 2012.

- Biologia Molecular de la Celula. Alberts B, Johnson A, Lewis J, Raff M, Roberts K, Walter P. 5ª ed., Ediciones Omega S.A. 2010. Original English edition: Molecular Biology of the Cell. Garland Science, 2007.

- Functional Biochemistry in Health and Disease. E. Newsholme and T. Leech. Ed. Wiley- Blackwell, 2009.

- Gene Control. Latchman DS, 2nd Ed. Garland Science, 2015.

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

- Marks F, Klingmüller U, Müller-Decker K. Cellular signal processing. Garland Sciences (2017, 2nd ed.).

- Molecular Biology of the Cell. Alberts B, Johnson A, Lewis J, Morgan D, Raff M, Roberts K, Walter P. 6th ed. Ed Garland Science, 2015.

- Steven AC, Baumeister W, Johnson LN,Perham RH.Molecular Biology of assemblies and machines. Garland Sciences (2016).

Review articles and web links available at "Campus Virtual".