Universitat Autònoma de Barcelona

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Cell Biology

Code: 101914
ECTS Credits: 6

Degree	Type	Year	Semester
2501230 Biomedical Sciences	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

Prerequisites

Since Cell Biology is a first semester subject of the Bachelor's Degree in Biomedical Sciences, there are no prerequisites to attend it. However, to ensure the proper class follow-up, it is recommended that students have a previous knowledge of basic biology. This would mostly include general aspects of the cell structures and their organic composition (proteins, nucleic acids, carbohydrates and lipids), as well as the main cellular metabolic pathways.

Moreover, given to the fact that most scientific information sources are in English, it is recommended that students have a basic knowledge of this language.

Objectives and Contextualisation

Cell Biology is a basic subject of the Bachelor's Degree in Biomedical Sciences at the Universitat Autònoma de Barcelona. It is aimed to establish a solid knowledge about the structural eukaryotic cell organization as well as their functioning and regulation. These contents will be complemented by other basic and compulsory subjects of the Biomedical Sciences study plan like Medical Genetics, Histology and General Physiology, or Molecular Biology of Cells. As a whole, these matters will provide a good understanding of the structural and functional organization of the living organisms.

On the other hand, the theoretical contents provided by this subject will be complemented by a practical laboratory training in the subject "Laboratory I" which integrates the practical content of all first-year subjects included in this Bachelor's Degree.

The basic knowledge provided by the subject Cell Biology, is fundamental to follow-up other optional subjects of the study plan. This is the main reason why this subject is comprised in the first semester of the first year of the study plan.

According to this context, the specific Training Goals that have been established by the teaching program of this subject are the following:

- To recognize the main differences between prokaryotes and eukaryotes.

- To describe the structure, composition and main features of cell membranes.

- To explain the organization and composition of other elements of the cell surface.

- To describe the transport processes through cell membranes.

- To describe the structure, composition and function of the different compartments of eukaryotic cells, as well as the relationships between them.

- To explain the role of mitochondriain cell bioenergetics.

- To describe the protein classification systems and their intracellular distribution pathways.

- To describe the chromatin composition and its organization along the cell cycle.

- To list the cytoskeleton elements and describe their composition and structure.

- To explain the contribution of the cytoskeleton to the cell shape and movement.

- To identify and describe molecules, structures and processes involved in the cell communication with the external environment and other cells.

- To identify molecules involved in the cell cycle regulation and explain their role.

- To list and describe the different mitotic and meiotic phases and to compare both types of cell divisions.

- To relate the eukaryotic cells functioning with the occurrence of some diseases.

- To integrate and apply the theoretical knowledge in interpreting and resolving basic scientific experiments of cell biology.

- To use the appropriate scientific terminology in the field of cell biology.

Skills

- Contribute to public discussions on cultural matters.
- Describe biomedical problems in terms of causes, mechanisms and treatments.
- 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 knowledge of the concepts and language of biomedical sciences in order to follow biomedical literature correctly.
- Generate innovative and competitive proposals for research and professional activities.
- Identify and understand the advances and challenges of research.
- Show respect for the ethical and legal aspects of research and professional activities.
- Work as part of a group with members of other professions, understanding their viewpoint and establishing a constructive collaboration.

Learning outcomes

1. Contribute to public discussions on cultural matters.
2. Describe the processes of cell differentiation, specialisation and death.
3. Develop critical thinking and reasoning and communicate ideas effectively, both in the mother tongue and in other languages.
4. Develop independent learning habits and motivation to continue training at postgraduate level.
5. Develop independent learning strategies.
6. Develop scientific knowledge, critical reasoning and creativity.
7. Generate innovative and competitive proposals for research and professional activities.
8. Identify and understand the advances and challenges of research.

9. Integrate the functions of the different organelles and cell structures with the overall functioning of the cell.
10. Relate the structure of the different parts of a cell to their functioning.
11. Show respect for the ethical and legal aspects of research and professional activities.
12. Use the bibliographic sources specific to cell biology, cytology and histology and genetics to work independently on acquiring further knowledge.
13. Work as part of a group with members of other professions, understanding their viewpoint and establishing a constructive collaboration.

Content

BLOCK I-INTRODUCTION

Unit 1. Introduction: organization of prokaryotic and eukaryotic cell. Main features and differences between prokaryotes and eukaryotes.

BLOCK II- CELL SURFACE

Unit 2. Structure and composition of the plasma membrane. Functions, structure and composition of the plasma membrane. Features of the cellular membranes: fluidity and asymmetry.

Unit 3. Transport of molecules through the membrane. Simple diffusion and osmosis. Transport of ions and small molecules: passive transport through permeases and channels. Primary and secondary active transport.

Unit 4. Extracellular matrix and cell wall. Extracellular matrix in animal cells: composition and functions, communication between cells and extracellular matrix, diseases related to extracellular matrix. The plant cell wall.

Unit 5. Unions and cell adhesion. Cell junctions: tight unions, anchoring junctions, gap junctions. Cell adhesion: cell adhesion molecules.

BLOKC III- INTRACEL·LULARS COMPARTMENTS

Unit 6. Introduction to the intracellular compartments and protein sorting. Cell compartmentalization and topological relationship. Intracellular protein sorting.

Unit 7. Nucleus. Nuclear structure: nuclear envelope, nuclear lamina, and nuclear pore complex. Nucleolus. Chromatin composition and structure. Chromatin organization into the nuclei.

Unit 8. Cytosol. Composition and structural organization. Functions: protein folding, posttranslational protein modification and processing, protein degradation. Diseases originated byprotein misfolding.

Unit 9. Endoplasmic reticulum. Introduction to the endomembrane system. Structure and composition of the endoplasmic reticulum. Functions of the smooth endoplasmic reticulum. Functions of the rough endoplasmic reticulum. Quality control of synthesized proteins and related diseases.

Unit 10. Golgi apparatus. Structure and composition of the Golgi apparatus. Basics of vesicular transport. Transport from the reticulum to the Golgi, and within the Golgi. Protein sorting at the trans-Golgi network.

Unit 11. Endosomes, lysosomes and vacuoles. Endosomes: classification and functions in endocytosis processes. Lysosomes: structure and obtainment of the digestion material. Lysosomal storage diseases. The vacuole of plant cells.

Unit 12. Mitochondria. Introduction to the semi-autonomous organelles. Mitochondria structure and composition. Biogenesis. Mitochondrial diseases. Mitochondrial functions: cellular bioenergetics.

Unit 13. Peroxisomes. Structure and composition. Biogenesis. General functions of peroxisomes. Specific functions of peroxisomes in animal cells and plant cells. Peroxisomal disorders.

BLOCK IV- CYTOSKELETON

Unit 14. Microfilaments. Introduction to the cytoskeleton. Microfilaments structure and composition. Types of microfilaments. Actin polymerization. Actin-binding proteins. Actin motor proteins and functions. Diseases related to the actin cytoskeleton.

Unit 15. Microtubules. Microtubules structure and composition. Microtubules classification. Tubulin polymerization. Microtubule-associated proteins. Microtubule motor proteins and functions. Diseases related to the microtubules cytoskeleton.

Unit 16. Intermediate filaments. Structure and composition of intermediate filaments. Classification. Polymerization. Intermediate filaments- associated proteins. Intermediate filament human disorders.

BLOCK V- CELLULAR REGULATION

Unit 17. Cell signaling. Basic principles of cell signaling. Intracellular receptors. Cell surface receptors: G protein-associated receptors and representative pathways; enzyme-associated receptors and representative pathways; receptors with intrinsic enzymatic activity and representative pathways.

Unit 18. Cell cycle. Phases of the cell cycle. Cell-cycle control system. Cell cycle machinery and checkpoints. Cell cycle deregulation and tumoral processes.

Unit 19. Mitosis. Phases of mitosis. Spindle organization. Cytokinesis

Unit 20. Meiosis. Phases of meiosis. Gametogenesis. Sinaptonemal complex and genetic recombination. Chromosome segregation. Aneuploidy syndromes.

Methodology

The subject of Cell Biology includes Theoretical classes and Classroom practices. Below, the organization and teaching methodology for these two types of training activities are described:

Theoretical classes:

The content of the theoretical program will be taught mainly in the form of master classes with audiovisual support. This will include *PowerPoint* projections that will contain an index for each unit with the most important points that will be described, illustrative schemes of the contents, and also images of cells or their components in order to get the students familiar with the real cell structure and organization.

The teacher will make available to the students the supplemental audiovisual material throughout the *Moodle classroom* of the subject in order to facilitate the lesson follow-up. It is recommended that students bring this material to class as a support when taking notes. Some animations and videos related to cellular processes described in specific units will also be displayed.

Students will be advised that, on a regular basis after class, to consult the recommended books listed in the Bibliography section of this Study Guide in order to consolidate and clarify, if necessary, the contents described. In addition, it will also be recommended that they consult the links made available through the *Moodle classroom* with additional videos and animations which, for time limitations or content prioritization, cannot be exhibited in class.

In addition to the teacher's explanations follow-up, the preparation of some contents of the program will require an active role of the student through alternative methodologies that will require the development of transversal and generic competences related to autonomous learning. Specifically, students will be required to prepare some Units of the program based on some guidelines provided by the teacher. These guidelines will consist of a detailed index of the contents and the most important concepts that the students must acquire. The teacher will suggest an indicative calendar to temporarily distribute the preparation of these Units along the semester, as well as the sessions for the resolution of doubts related to these contents. This will allow to adapt both the progress of the Theory program and the Classroom Practices.

Classroom practices:

During these sessions the students will present the resolution of experimental problems related to the contents of the theoretical classes to the rest of the class. In general in these sessions, no additional content of the program will be presented, as these classes are mostly aimed to consolidate and facilitate the comprehension of the contents presented in the Theoretical classes. In addition, these sessions are also intended to make the student familiar with the interpretation of scientific data and the resolution of problems based on real experimental situations.

In these sessions, students will be distributed in groups of four people. In each session, students will present the resolution of the exercises in which they had previously been working outside the classroom and that are programmed for that class. At the beginning of the semester, the teacher will provide the students through the *Moodle* classroom with the dossier compiling all exercises to work along the course, as well as the calendar of submissions and presentations. Specifically, four problems will be presented in each session. Students must have previously submitted the written resolution of these exercises through the *Moodle* classroom (each group has to make a single submission with the corresponding four exercises). In each session, the teacher will ask a member of a team to explain the resolution of a problem to the rest of the class. The students who make these exhibitions will be chosen by the teacher who will ensure that all students present at least one exercise throughout the course. The teacher will evaluate both the presentations made by the students as well as a selection of the problems submitted in writing. The qualification obtained from these two methodologies will be common for all members of the group.

The use of English in these sessions will be promoted. In this sense, the use of this language in these sessions by all members of a group will be recognized in their final mark as described in the "Evaluation" section.

On the other hand, once the exercises programmed for each Classroom Practices have been resolved, the remaining available time will be focused to promote the debate and the exposition of doubts related to important concepts of the Units that students must prepare autonomously.

Activities

Title	Hours	ECTS	Learning outcomes
Type: Directed			
Lecture classes	36	1.44	2, 8, 9, 10, 12
Problem classes	9	0.36	11, 1, 2, 4, 3, 7, 8, 9, 10, 13, 12
Type: Autonomous			
Individual study	54	2.16	2, 6, 5, 4, 8, 9, 10, 12
Problem resolution in groups	16	0.64	1, 2, 6, 5, 4, 7, 8, 9, 10, 13, 12
Self-learning contents	26	1.04	1, 2, 6, 5, 4, 8, 9, 10, 13, 12

Evaluation

The evaluation of the competences acquired by the student along the course will be evaluated continuously. For this purpose, different assessment systems will be used to verify that the student has achieved the various learning outcomes defined by the subject:

Evaluation of the contents related to the Theoretical classes

The contents related to the Theoretical classes will have a weight of 80% on the final grade of the subject. Throughout the course there will be two partial tests related to these contents that the students will have to answer individually. These tests will consist of a series of objective questions that will allow determining if the students have understood and acquired the conceptual knowledge required to pass the subject, as well as if

they know how to integrate and relate them. These tests will also include questions related to the Units that students will have prepared autonomously in order to evaluate the corresponding learning outcomes.

The **first partial test** will have a weight of 40% on the final mark, and will include the contents taught up to that moment (it will include two Units that students have had to prepare autonomously).

The **second partial test** will include the rest of the contents (although some questions can also indirectly refer to aspects of the Units evaluated in the first partial). This test also will include two Units that students must have prepared autonomously. The weight of this second test on the final mark will be 40%.

The **final test** will represent 80% of the final mark and will integrate the contents of the whole course organized in two parts. Each one of these parts will include the contents related to the two previous partial tests.

Evaluation of the contents related to Classroom Practices

The contents related to the Classroom Practices will have a weight of 20% on the final mark. In this part, it will be evaluated the students' teamwork in solving experimental problems related to the theoretical content of the subject.

Eachteam will have to provide the resolution of the problems programmed for each one of the sessions in writing according to the calendar indicated by the professor (a single submission by each group). The students will have at their disposal the forms to be downloaded from the Campus virtual and to fill with the answers. These filled documents will be submitted online through the corresponding application of the *Moodle* classroom programmed by the teacher. Of all problems collected during the semester, the teacher will choose three of them to be evaluated and qualified for all groups. All members of each team will receive the same mark, which will have a weight of 10% in the final grade of the subject. This assessment will take into account that students have understood the problem's approach, that they have interpreted the data properly, and that they have reached the correct answer.

On the other hand, in each session, four students will be asked to orally present the resolution of the exercises programmed for that session. The students will be chosen by the teacher that will ensure that all of them will present at least one exercise to the rest of the class throughout the course. The teacher will evaluate the expositions taking into account not only the results presented and their understanding, but also the student's ability to communicate, as well as the clarity and organization of the exhibition. If necessary, the teacher will make some questions to the student in order to verify that he really understood and worked on the problem. The qualification obtained in each exhibition will be applicable to all members of the group regardless of who has done the exhibition, and will represent 5% of the final grade of the subject. In these exhibitions the participation of the other teams will be encouraged either by discussing the results presented or by assessing the possibility of other valid answers. This will also allow ensuring that all students have understood the exercise.

Furthermore, each student will have to resolve individually a problem of similar characteristics to the ones worked during the course. This exercise will be carried out together with the 2nd partial test and only those students that not allowed to perform this 2nd exam will be able to solve the exercise during the final test. The grade obtained in this exercise will represent 5% of the final mark of the subject.

In parallel to the submission of the solved exercises, at mid-semester and at the end of the course, all students must submit a questionnaire related to the functioning of the team work. This questionnaire (in the form of an evaluation matrix) will be prepared by the teacher and will be made available to students through the Virtual Campus. In this survey, each member of a team will have to evaluate his own participation and that of the rest of the group mates. The objective is to supervise the development of the team-work and to be able to detect those students who do not participate or that interfere in the group tasks. Although the results of these questionnaires will not have a specific weight in the final grade of the subject, in case of detecting a negative evaluations of a student by the rest of the members of his group indicating a lack of participation in the team-work, the final qualification of the group will not be applied to this student, or his mark will be penalized.

QUALIFICATION SISTEM

In the evaluation of the **contents of Theory**, in order to be able to access to the 80% of the mark corresponding to this part, the students will be able to perform two partial tests and a final exam. In order to

take into account the marks obtained in the two partial tests, it is necessary to obtain a qualification greater than 4 points (out of 10) in each one of them. The students who do not achieve this mark will be able to assist to the correspondingparts in the Final exam. To be eligible for the retake process in the final exam, the student should have been previously evaluated in the two previous partial exams. If a student who has passed the subject by performing the two partial tests decides to assist at the final exam to improve the obtained mark, he will lose all previously obtained partial notes.

In the evaluation of the **contents related to the Classroom Practices**, to access to the 20% of the mark corresponding to this part, students will have to be part of a team that has submitted on-time all problems proposed, have exposed at least one problem in class, and solved a problem individually during the exam. In case all members of a team decide to use English both for the written submissions and the oral presentations, the mark obtained from these parts will be multiplied by x1.2. If a student does not participate in the tasks of their team or in the oral presentations, he only will be able to obtain the 5% of the note corresponding to the resolution of a problem individually.

The maximum qualification that can be obtained after completing all these activities will be 10 points (out of 10). To be able to pass the subject it will be necessary that the following premises are fulfilled:

- To obtain a grade equal to or greater than 4 points (out of 10) in each partial test or in the corresponding parts of the final exam.

- To obtain an overall score of ≥5 (out of 10) from all evaluations received.

The summary of all factors to take into account in the qualification systems established in this subject are described in the following table:

	QUALIFICATIONS OBTAINED	WEIGHT	REQUIREMENTS	ADDICIONAL FACTORS
THEORY 80%	Mark from the 1r partial test	40%	≥4 points (out of 10)	Marks can be retrieved by performing the corresponding parts of the Final exam To improve the qualification, it will be necessary to perform the whole Final Exam
	Mark from the 2n partial test	40%	≥4 points (out of 10)	
	Mark from the Final Exam	80%	≥4 points (out of 10) in each part	Its execution involves losing all previous partial marks
CLASSROOM PRACTICES 20%	Average of the correction of 3 delivered problems	10%	Each team must have submitted the 32 exercises	Teamwork questionnaires must be satisfactory

Average of all oral presentations	5%	Each member must orally present an exercice	If it is done in English, the mark will be multiplied x1.2
Mark of the exercise resolved individually	5%	-	-
FINAL MARK	**100%**	**≥5 points (out of 10) from all evaluations**	**-**

A student will receive the condition of "**Non-Graded**" if the weight of all conducted evaluation activities is less than 67% of the final score. Therefore, any student that only performs one of the Partial Tests (even if they are part of a team in the Classroom Practices and perform the corresponding evaluation activities) will receive the condition of "**Non-Graded**".

In case a student does not pass the subject in a given academic course, the marks obtained in the classroom practices will be kept for the next course whenever the competences associated with this section have been obtained (obtaining >5 points out of 10 when considering all the assessed activities). Otherwise, they will have to repeat them again in order to obtain the corresponding grade. This exemption will be maintained for a period of three additional enrollments.

Those students that are unable to attend to an exam for a justified cause (such as a health problem, a family member's death to a second degree, an accident, elite student athletes that have a competition of forced attendance, etc.) and provide the official documentation to the degree coordinator (official medical certificate that explicitly confirms the inability to carry out the exam, police attestation, justification from the competent sports organization, etc.), will be entitled to perform the test another day. Both the Bachelor's degree Coordinator and the teacher will do as much as possible to solve this situations.

Evaluation activities

Title	Weighting	Hours	ECTS	Learning outcomes
Final exam	80%	3	0.12	2, 6, 5, 8, 9, 10, 12
First partial exam	40%	3	0.12	2, 6, 5, 8, 9, 10, 12
Problem resolution, delivery and presentation	20%	0	0	11, 1, 2, 4, 3, 7, 8, 9, 10, 13, 12
Second partial exam	40%	3	0.12	2, 6, 5, 8, 9, 10, 12

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