Universitat Autònoma de Barcelona

2019/2020

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 for taking it. However, it is recommended that students have previous knowledge of basic biology, so that they can follow the classes. This would mostly include general aspects of cell structures and their organic composition (proteins, nucleic acids, carbohydrates and lipids), as well as the main cellular metabolic pathways.

In addition, since most scientific information sources are in English, it is advisable to have a good grounding in this language.

Objectives and Contextualisation

Cell Biology is a basic subject of the Bachelor's Degree in Biomedical Sciences at the Autonomous University of Barcelona. The course aims to establish sound knowledge of the structural organization, functioning and regulation of eukaryotic cells. These contents will be complemented by those of other basic and compulsory subjects within the Biomedical Sciences study plan, like Medical Genetics, Histology and General Physiology, and Molecular Cell Biology. Together, these subjects will provide a good understanding of the structural and functional organization of living organisms.

The theoretical contents corresponding to this subject will be complemented by practical laboratory training in the subject "Laboratory I" which integrates the practical content of all first-year subjects included in this Bachelor's Degree (for more information, see the corresponding Study Guide).

The following are the specific training goals of the subject Cell Biology.

- 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 mitochondria in cell bioenergetics.

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

- To describe chromatin composition and its organization throughout 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 a cell's communication with the external environment and other cells.

- To identify molecules involved in 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 functioning of eukaryotic cells with the occurrence of some diseases.

- To integrate and apply knowledge of theory when interpreting and resolving basic cell biology experiments.

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

Competences

- 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 by protein 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. 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 of peroxisomes. 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. Microtubule structure and composition. Microtubule classification. Tubulin polymerization. Microtubule-associated proteins. Microtubule motor proteins and functions. Diseases related to the microtubule-cytoskeleton.

Unit 16. Intermediate filaments. Structure and composition of intermediate filaments. Intermediate filaments classification. Polymerization. Intermediate filaments and associated proteins. Human disorders related to intermediate filaments malfunctioning.

BLOCK V- CELLULAR REGULATION

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

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 Theory classes and Problem-based classes. Below, the organization and teaching methodology for these two types of training activities are described.

Theory classes

The content of the Theory program will be taught mainly in the form of formal lectures with audio-visual support. This will include PowerPoint presentations containing an index for each unit with the most important points that will be described, illustrative schematics of the contents, and also images of cells or their components, to familiarize students with real cell structure and organization. The teacher will make supplementary audio-visual material available to the students through the Moodle classroom of the subject, to help them follow the lectures. They are recommended to 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 to consult the recommended books listed in the Bibliography section of this Study Guide on a regular basis, in order to consolidate and, if necessary, clarify the contents described. In addition, it will also be recommended that they consult the links made available through the Moodle classroom: to additional videos and animations that, due to time constraints or content prioritization, cannot be shown in class.

As well as in the follow-up to lectures, students are also expected to play an active role in preparing certain course contents, which involves using alternative methodologies and requires them to develop transferable and generic competences related to independent learning. Specifically, students will be required to prepare some units of the program based on 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 approximate calendar to distribute the preparation of these units over the semester, together with sessions for dealing with any queries related to these contents. This calendar will be flexible enough to adapt to the progress of the Theory program and the Problem-based classes.

Problem-based classes

During these sessions students will give presentations to the rest of the class, offering solutions to experimental problems related to the contents of the Theory classes. In general in these sessions, no

additional programmed content will be presented, as their main aim is to consolidate and facilitate comprehension of the contents presented in the Theory classes, and to familiarize students with interpreting scientific data and problem-solving through real experimental situations.

In these sessions, students will be distributed in groups of four. They will present their solutions to the exercises they had previously been working on outside the classroom, as scheduled for that class. At the beginning of the semester, through the Moodle classroom, the teacher will provide the students with a dossier containing all the exercises to work on over the course, along with the calendar of submissions and presentations. Specifically, four problems will be presented in each session. Students must have previously submitted their written answers to these exercises through the Moodleclassroom (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 solution to a problem to the rest of the class. The students who give these presentations will be chosen by the l 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 and a selection of the problems submitted in writing. The mark obtained from these two methodologies will be the same for all members of the group.

The use of English inthese sessions will be encouraged. To this end, the use of this language in these sessions by all members of a group will be rewarded in their final mark, as described in the following section.

Once the exercises programmed for each session have been completed, the remaining available time will be devoted to debate and students' queries about important concepts in the units that they must prepare independently.

Activities

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Problem-based classes	9	0.36	11, 1, 2, 4, 3, 7, 8, 9, 10, 13, 12
Theory classes	36	1.44	2, 8, 9, 10, 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

Assessment

Students' progress in acquiring competences on the course will be monitored through continuous assessment. For this purpose, different assessment systems will be used to verify that the student has achieved the various learning outcomes established for the subject.

Assessment of contents taught in Theory classes

The contents taught in Theory classes will have a weight of 80% of the final grade for the subject. During the course there will be two interim tests related to these contents that the students will have to take individually. These tests will consist of a series of objective questions to show whether the students have assimilated the concepts required to pass the subject, and whether they know how to integrate and interrelate them. These tests will also include questions on the units that students will have prepared on their own, in order to evaluate the corresponding learning outcomes.

The first interim test will have a weight of 40% of the final mark, and will focus on the contents taught up to that moment including two units that students have had to prepare independently.

The second interim test will include the rest of the contents (although some questions can also indirectly refer to aspects of the units evaluated in the first test). This test will also include two units that students have to prepare independently. The weight of this second test in the final mark will be 40%.

The final exam will integrate the contents of the whole course and will be in two parts. Each of these parts will include the contents related to the two previous interim tests and thus they will again represent 40%+40% of the final mark.

Assessment of contents taught in Problem-based classes

The contents related to the Problem-based classes will have a weight of 20% of the final mark. In this part, students' teamwork when solving experimental problems related to the theoretical content of the subject will be assessed.

Each team will have to provide solutions to the problems programmed for each session according to the calendar set by the teacher (a single submission from each group). The corresponding answer sheets should be downloaded from the Campus Virtual and submitted online through the Moodle classroom application set up by the teacher. Of all problems collected during the semester, the teacher will choose three to be evaluated and marked for all groups. All members of each team will receive the same mark, which will have a weight of 10% in the final grade for the subject. This assessment will take into account whether students have understood how to approach the problem, whether they have interpreted the data properly, and whether they have reached the correct answer.

Additionally, in each session, four students will be asked to orally present the solutions to the exercises programmed for that session. These students will be chosen by the teacher to ensure that everyone will present at least one exercise to the rest of the class during the course. The teacher will evaluate these presentations not only on the results presented and their understanding, but also on the student's ability to communicate, clarity and organization. If necessary, the teacher will ask questions to verify that the presenters have really understood and worked on the problem. The mark obtained for each presentation will be applicable to all members of the group regardless of who has given it, and this mark will represent 5% of the final grade for the subject. In these presentations 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 help to ensure that all students have understood the exercise.

Furthermore, each student will individually have to solve a problem of similar characteristics to the ones workedon during the course. This exercise will be carried out together with the second interim test and the mark obtained will represent 5% of the final grade for the subject.

In parallel to the submission of the completed exercises, at mid-semester and at the end of the course, all students must submit their responses to a questionnaire about the functioning of their team. 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 it, each member of a team will have to evaluate his/her own participation and that of his/her team-mates. The objective is to track the development of teamwork and to be able to detect students who do not participate or interfere in the group tasks. Although the results of these questionnaires will not have a specific weight in the final grade of the subject, if a student is evaluated negatively by the rest of the team, indicating a lack of participation in the team's work, the final mark for the team will not be applied to this student, or his/her mark will be lowered.

MARKING SYSTEM

Regarding the Theory contents, in order to have the right to the 80% of the final grade corresponding to this part, students will be able to perform two interim tests and a final recovery exam. For the marks obtained in the two interim tests to be taken into account, it is necessary to obtain a mark higher than 4 (out of 10) in each one of them. Students who do not achieve this mark will be able to retake the corresponding parts 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 interim tests. If a student who has passed the subject by performing the two interim tests decides to take the final exam to improve the mark obtained, he/she will lose all previously obtained interimmarks.

In the assessment of the contents related to the Problem-based classes, in order to have the right to the 20% of the final grade corresponding to this part, students should have been part of a team that has punctually submitted all problems set, should have presented at least one problem in class, and should have solved a problem individually during the exam. If 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 1.2. Students who do not participate in the tasks of their team or in the oral presentations will only be able to obtain the mark corresponding to individual problem-solving: 5% of the final grade.

Globally, the maximum mark that can be obtained after completing all these activities will be 10 points (out of 10).

To be able to pass the subject, the following conditions must be fulfilled.

- Obtaining a mark equal to or greater than 4 points (out of 10) in each interim test or in the corresponding parts of the final exam.

- Obtaining an overall mark of ≥5 (out of 10) for all assessments received.

All the factors to be taken into account in the marking systems established for this subject are described in the following table:

MARKS OBTAINED			WEIGHT	MINIMUM MARK TO QUALIFY	ADDITIONAL FACTORS
THEORY CLASSES 80%	Mark for the 1st interim test		40%	≥4 points (out of 10)	- Students with a fail mark can retake the corresponding part in the final exam (they should have been previously evaluated in the two previous interim tests)
	Mark for the 2nd interim test		40%	≥4 points (out of 10)	
	Final exam	Mark for the reassessment of the 1st interim test	40%	≥4 points (out of 10)	- Trying to improve the marks obtained implies losing the previously obtained interim marks
		Mark for the reassessment of the 2nd interim test	40%	≥4 points (out of 10)	
PROBLEM-BASED CLASSES 20%	Average mark for 3/32 submitted problems		10%	N/A	- Each team must have submitted the 32 exercises
			5%	N/A	

	Average mark for all oral presentations			- Each member must orally present an exercise - Teamwork questionnaires must be satisfactory - If it is done in English, the mark will be multiplied by 1.2
	Mark for the exercise completed individually	5%	N/A	N/A
FINAL MARK		100%	≥5 points (out of 10)	

Students will be considered "not assessable" if the combined weight of all the evaluation activities they have done is less than 67% of the final mark. Therefore, any students who do not perform any interim test, or only one them (even if they are part of a team in the Problem-based classes and perform the corresponding evaluation activities) will be considered "not assessable".

Students who engage in misconduct (plagiarism, copying, personation, etc.) in an assessment activity will receive a mark of "0" for the activity in question. In the case of misconduct in more than one assessment activity, the students involved will be given a final mark of "0" for the subject.

In the case of students who do not pass the subject in a given academic year, the marks obtained in the Problem-based classes will be kept for the next year whenever the competences associated with these classes have been obtained (obtaining >5 points out of 10 when considering all the assessed activities). Otherwise, they will have to repeat the evaluation activities to obtain the corresponding grade. This exemption will be maintained for a period of three additional enrolments.

Students who are unable to attend an exam due to extenuating circumstances (i.e. health problem, death of a first- or second-degree relative, an accident, or unavoidable competitions in the case of elite student athletes) and who provide the official documentation to the degree coordinator (respectively: official medical certificate that explicitly confirms the inability to carry out the exam, police statement, justification from the competent sports organization.), will be entitled to perform the test on another day. Both the Bachelor's Degree coordinator and the teacher will do as much aspossible to resolve these situations.

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Final reassessment exam	80%	3	0.12	2, 6, 5, 8, 9, 10, 12
First interim test	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 interim test	40%	3	0.12	2, 6, 5, 8, 9, 10, 12

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