Universitat Autònoma de Barcelona

2017/2018

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 a 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 of the 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 and thus 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 Genetics, Structure and Function of Biomolecules, Histology and General Physiology, or Immunology. As a whole, they 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 integrated subject "Laboratory I".

The basic knowledge provided by the subject Cell Biology, besides complementing the previously described subjects, will be fundamental to integrate the contents of other optional subjects of the Biomedical Sciences study plan. This is the main reason why the subject Cell Biology is taught in the first semester of the first year of this Bachelor's Degree.

Regarding the formative objectives, at the end of this subject the student will be able...:

1. To recognize the main differences between prokaryotes and eukaryotes.
2. To describe the structure, composition and main features of cell membranes.
3. To explain the organization and composition of other elements of the cell surface.
4. To describe the transport processes through cell membranes.
5. To describe the structure, composition and function of the different compartments of eukaryotic cells, as well as the relationship between them.

6. To explain the role of mitochondria in cell bioenergetics
7. To describe the protein classification systems and their distribution pathways.
8. To describe the chromatin composition and its organization along the cell cycle.
9. To list the cytoskeleton elements and describe their components and structure.
10. To explain the cytoskeleton contribution to the cell shape and movement.
11. To identify and describe molecules, structures and processes involved in the cell communication with the external environment and with other cells.
12. To identify molecules involved in the cell cycle regulation and to explain their role.
13. To list and describe the different mitotic and meiotic phases and to compare them.
14. To relate the functioning of eukaryotic cells and the occurrence of some diseases.
15. To integrate and use the theoretical knowledge for interpreting results from plain scientific experiments and to resolve experimental problems of cell biology.
16. 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

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

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

Tema 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.

Tema 4. Extracellular matrix and cell wall. Extracellular matrix in animal cells: composition and functions. Communication between cells and their extracellular matrix. Diseases related to extracellular matrix. The plant cell wall.

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

Tema 6. Introduction to the intracellular compartments and protein sorting. Cell compartmentalization. Intracellular protein sorting.

Tema 7. Nucleus. The nuclear envelope, the nuclear lamina, and the nuclear pore complex. Nuclear structure. Bidirectional transport nucleus-cytoplasm. Structure of the nucleolus. Ribosomal RNA synthesis. Chromatin composition and structure. Chromatin organization into the nuclei. Euchromatin and heterochromatin. Chromosome organization and structure.

Tema 8. Cytosol. Components and structural organization. Functions: protein folding, posttranslational protein modification and processing, protein degradation.

Tema 9. Endoplasmic reticulum. Introduction to the endomembrane system. Structure and composition of the endoplasmic reticulum. Functions of the smooth endoplasmic reticulum. Synthesis of lipids and cellular detoxification. Functions of the rough endoplasmic reticulum. Soluble protein and membrane protein synthesis. Protein modifications. Protein quality control.

Tema 10. Golgi apparatus. Structure and composition of the Golgi apparatus. Basis of vesicular transport: type of vesicles, vesicles formation and fusion with a target membrane. Transport from the reticulum to the Golgi, and within the Golgi. Reticulum-resident proteins recovery. Oligosaccharide modifications. Lipid and polysaccharide metabolism. Protein sorting at the trans-Golgi network. Transport of lysosomal proteins. Constitutive secretion and regulated secretion. Retention of Golgi-resident proteins.

Tema 11. Endosomes, lysosomes and vacuoles. Structure and composition of endosomes. Classification and function. Endocytosis (phagocytosis and pinocytosis). Structure and composition of lysosomes. Obtainment of the digestion material (autophagy and heterophagy). Genetic defects in the production of acid hydrolases. The vacuole of plant cells.

Tema 12. Mitochondria. Mitochondria structure and composition. Biogenesis. Mitochondrial genome and protein synthesis. Mitochondrial lipid and protein import. Functions of mitochondria. Cellular respiration. Mitochondrial oxidation. Electron transport. ATP synthesis. Transport across the inner mitochondrial membrane. Heat production. Production of biosynthetic precursors.

Tema 13. Peroxisomes. Structure and composition of peroxisomes. Biogenesis. Peroxisomal lipid and protein import. Genetic diseases related to protein import. General functions of peroxisomes. Oxidative reactions and fatty acid oxidation. Specific functions of peroxisomes in animal cells and plant cells.

Tema 14. Microfilaments. Microfilaments structure and composition. Actin polymerization. Actin-binding proteins. Microfilament organization in muscle cells and non-muscle cells. Cell movement.

Tema 15. Microtubules. Microtubules structure and composition. Tubulin polymerization. Microtubule-associated proteins. Labile microtubules. Stable microtubules (centrioles, cilia and flagella): organization, function and biogenesis.

Tema 16. Intermediate filaments. Structure and composition of intermediate filaments. Polymerization. Intermediate filaments- associated proteins. Functions.

Tema 17. Cell signaling. Basic principles of cell signaling. Intracellular receptors. Cell surface receptors: G protein-associated receptors, enzyme-associated receptors. Signal integration.

Tema 18. Cell cycle. Phases of the cell cycle. Cell cycle control. Cell cycle machinery and checkpoints.

Tema 19. Mitosis. Phases of mitosis and spindle organization. Cytokinesis

Tema 20. Meiosis. Phases of meiosis. Sinaptonemal complex and chromosome synapsis. Genetic recombination.

Methodology

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

Lecture classes:

The content of the theoretical program will be taught mainly in the form of master classes with audiovisual support. The teacher will make available throughout the Moodle of the subject the supplemental audiovisual material to the students in order to facilitate the lesson follow-up. It is recommended that students bring this material to class as a support when taking notes. Although it is no necessary to extend the class contents -unless this is particularly request by the teacher- it is recommended that students regularly consult the books listed in the Bibliography section of this Study Guide to consolidate, and if necessary, to clarify their doubts.

The follow-up of this subject will also require an active role of the student who will have to prepare a number themes of the program on their own according to the guidelines provided by the teacher. The objective of this activity is to promote that the students learn how to find, interpret and synthesize information from bibliographic sources as well as working independently. The self-learning information collected by the students will constitute personal study material and it will not have to be delivered to the teacher.

Problem classes:

These sessions will be aimed to resolve and discuss 32 experimental problems related to the contents of the subject program. These activities are intended to consolidate the theoretical contents (either those presentially taught but also those prepared through self-learning activities), as well as makingthe studentsto become familiar with different cell biology methodologies, scientific data interpretation, and assessment of real experimental situations.

Students will have to work in groups and deliver the solutions to the problems according to the schedule set by the teacher (one drop per group). These problems will be discussed and corrected in class with the active participation of the students. Specifically, the teacher will ask a member of each group to present the solution of an exercise to the rest of the class. This exposition will be assessed by the teacher, and the grade obtained will be applied to the rest of members of the same working group (see the section "Evaluation").

At the end of the course, the teacher will select, evaluate, and correct three delivered exercises (the same for all groups). The average grade obtained in this assessment, which will be the same for all members of a given group, will contribute to the final mark of the subject (see the section "Evaluation").

Also, the particular ability of each student to individually solve a scientific problem will also be evaluated. This activity will be performed together with the second partial test or, alternatively, with the final exam (see the section "Evaluation"). This exercise will have similar characteristics to the problems resolved along the course.

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

This subject will be continuously evaluated along the semester, and its assessment will include the following activities:

1. Theoretical contents

There will be two partial tests that the students will have to answer individually. These tests will consist of a series of questions about the contents of the program, including those self-prepared by the students. The aim of these tests is to evaluate that the students have not only acquired the conceptual knowledge of the subject, but also that they have understood, and know how to integrate this information. Moreover, the inclusion of questions related to the contents self-prepared by the students, will allow assessing their individual competence to manage new information.

The mark obtained in the first partial test will represent 40% of the final grade and will include the contents of the period 12/09/17 - 25/10/17. The second partial test will include the contents of the period 6/11/17 - 21/12/17 although it may also indirectly refer to the contents of the first block of topics. This second exam will also account for 40% of the final grade. Alternatively, the students will have the option to perform a final exam that will include all the contents of the program, and represent 80% of the final grade.

Only those students who obtain a mark over 4 points (out of 10) in the first partial test will be able to attend at the second partial. Otherwise, they will have to take the final exam in order to pass the course.

In case of passing the first partial exam but obtaining less than 4 points (out of 10) at the second partial exam, they will have to perform the final exam in order to pass the course.

2. Problem classes

Each working group will have to deliver the resolution of the 32 exercises according to the schedule set by the teacher. The teacher will choose three of these problems and evaluate and qualify their assessment (the same exercises for all groups). All group members will receive the same grade which will represent 10% of the final mark. In this evaluation it will be evaluated the understanding of the exercise, the proper data interpretation, and the achievement of a right answer.

Furthermore, the teacher will also evaluate the oral presentations made by students of these exercises. In every session, the students that will present each exercise will be chosen in order that all of them present at least one problem along the course. The teacher will assess these presentations attaining not only to the correctness of the resolution, but also the understanding and communication ability of the students. If necessary, the teacher will ask questions to the students in order to verify that they truly understood the exercise and contributed to its resolution. The grade obtained in each presentation will be applied to all group members regardless of who had made the presentation, and it will represent 5% of the final mark.

In order to receive this mark, each group will have to deliver all the scheduled exercises in the proper timing and every member of the group will have to present at least a problem to the rest of the class.

On the other hand, students will have to individually resolve a problem similar than those worked in group along the semester. This exercise will be executed together with the 2nd partial test, and only those students who did not pass the 1st partial test will be able to perform this exercise with the final exam. The grade obtained in this evaluation will represent 5% of the final mark.

Those students that do not participate in the working group activities or do not orally present any exercise to the rest of the class, will only reveive the grade obtained in the individual resolution of an exercise in their final mark calculation (the grades of the remaining problem activities will be 0).

Itineraries

Students who want to follow a continuous assessment (Itinerary 1) will have to perform the two corresponding partial tests, being part of a working group that delivers 100% of the scheduled problems, presenting at least a problem to the rest of the class, and individually resolve a problem along with the 2nd partial exam. The maximum grade that they may obtain from completing all these tasks will be 10 points (out of 10). It will be necessary to obtain an overall score of 5 points (out of 10) in order to pass the course.

In case of obtaining a grade lower than 4 points (out of 10) in the first partial test, the student will not be able to perform the second partial test. In this case, it will be necessary to perform the final exam (Itinerary 2) that will include all the theoretical contents in order to pass the course.

In case of passing the first partial test but obtaining a grade lower than 4 points (out of 10) in the second partial test, the student will have to perform the final exam (Itinerary 2) that will include all the theoretical contents in order to pass the course. The requirements to pass the course when following Itinerary 2 will be the same as those that apply to Itinerary 1: being part of a working group that delivers 100% of the scheduled problems, presenting at least a problem in class, and individually resolve a problem along with the final exam. It will be necessary to obtain a grade of 4 (out of 10) at the final exam and an overall mark of all activities of 5 (outof 10) in order to pass the course.

Evaluation activities	Itinerary 1	Itinerary 2
THEORETICAL CONTENTS		
First partial exam	4	-
Second partial exam	4	-
Final exam	-	8
PROBLEM CLASSES		
Exercises delivered	1	1
Exercises orally presented	0,5	0,5

Exercise individually assessed	0,5	0,5
TOTAL	**10**	**10**

Definition of "Ungraded"

A student will get the qualification of "Ungraded" in case of not assisting to any partial test or to the final exam. Those student that perform the first partial exam but do not assist neither to the second partial test or to the final exam, will get the mark "failed".

Justified absence to the evaluation tests

Students unable to attend an exam due to a justified cause (such as illness, death of a first-degree relative, or accident) and provide official documentation to the Bachelor's degree Coordinator will be entitled to perform the test another day. Both the Bachelor's degree Coordinator and the responsible teacher will do as much as possible to solve this situations.

Grade improvement

Students that follow Itinerary 1 will be able to improve their final mark by performing the final exam. This will imply losing the marks previously obtained in the partial tests. In this case, the same conditions stablished for Itinerary 2 will be applied to pass the course.

Repeaters

In the case of not passing the course, the grades obtained in the activities related to the problems classes will be kept to the next course when the skills associated to this section have been accomplished (obtainment of >5 points out of 10 when considering all the problem activities). On the contrary, students will have to repeat them in order to obtain the required grades. This exemption will be maintained for a period of three additional enrollments.

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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