Cell Biology

Code: 100892
ECTS Credits: 6

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Degree	Type	Year
2500252 Biochemistry	FB	1

Contact

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Teaching groups languages

You can view this information at the end of this document.

Prerequisites

There are no prerequisites for taking this subject, as it is taught in the first semester of the first year of the Biotechnology degree. However, students should have a basic knowledge of Biology, specifically of the general structure of cells and their organic components (proteins, nucleic acids, carbohydrates and lipids) as well as of the main pathways of cell metabolism.

Additionally, as most sources of information in a scientific discipline such as Cell Biology are in English, it is recommended that students have a basic working knowledge of this language.

Objectives and Contextualisation

In this core subject, students are expected to acquire a solid knowledge of the structural organization, operation and regulation of eukaryotic cells. This knowledge is complemented with that of other core and mandatory subjects in the Biotechnology degree, such as Histology, Genetics, Biochemistry, Animal and Plant Physiology, Microbiology or Immunology. As a whole, this will provide Biochemistry students with a good understanding of the structural and functional organization of living organisms. Other subjects in the Biochemistry syllabus, such as Instrumental Techniques or Cellular Culture, will provide a more in-depth knowledge of the techniques used for the study of cells. This aspect is only briefly introduced in Cell Biology. The theoretical content of Cell Biology will be complemented with practical laboratory sessions in Integrated Laboratory 1.

After completing Cell Biology, students will be able to correctly follow many of the subjects listed above, as well as other optional subjects in the Biochemistry syllabus. For this reason, the Cell Biology course is taught in the first semester of the first year of the Biotechnology degree.

On completing the course, students will be able to:

1. Recognize the main differences between prokaryotic and eukaryotic cells.

2. Describe the structure, composition, and main characteristics of cell membranes.

3. Explain the organization and composition of other elements of the cell surface.

4. Describe the processes of transport across cell membranes.

5. Describe the structure, composition, and function of the distinct compartments of eukaryotic cells, as well as the relationships between them.

6. Explain the role of mitochondria and chloroplasts in cellular bioenergetics.

7. Describe the protein classification systems and their intracellular distribution pathways.

8. Describe the composition of chromatin and its organization in interphase and during cell division.

9. List the components of the cytoskeleton and describe their composition and structure.

10. Explain the contribution of the cytoskeleton to cell shape and movement.

11. Identify and describe the molecules, structures and processes involved in the relationship and communication of cells with the external environment and with other cells.

12. Identify the molecules involved in the regulation of the cell cycle and explain their function.

13. List and describe the different phases of mitosis and meiosis and compare the two types of cell divisions.

14. Relate the functioning of eukaryotic cells to the causes of certain diseases.

15. Integrate and apply the theoretical knowledge acquired in the subject to interpret the results of simple scientific experiments and to solve experimental problems.

16. Use scientific language appropriate to the field of cell biology.

Competences

- Act with ethical responsibility and respect for fundamental rights and duties, diversity and democratic values.
- Collaborate with other work colleagues.
- Describe intercellular and intracellular communication systems that regulate the proliferation, differentiation, development and function of animal and plant tissues and organs.
- Describe the structural, physiological and biochemical characteristics of the different types of cells and explain how their properties fit in with their biological function.
- Explain the structure of cell membranes and their role in signal transduction processes, the transport of solubles and the transduction of energy.
- Interpret experimental results and identify consistent and inconsistent elements.
- Introduce changes in the methods and processes of the field of knowledge to provide innovative responses to the needs and demands of society.
- Manage information and the organisation and planning of work.
- Read specialised texts both in English and one's own language.
- Stay abreast of new knowledge of the structure, organisation, expression, regulation and evolution of genes in living beings.
- Take responsibility for one's own learning after receiving general instructions.

Learning Outcomes

1. Act with ethical responsibility and respect for fundamental rights and duties, diversity and democratic values.
2. Collaborate with other work colleagues.
3. Describe the molecules, structures and processes involved in a cell's interaction and communication with the external environment and with other cells.
4. Explain the functioning and regulation of the cell cycle and cell division.
5. Explain the fundamental principles of genetics and reproduction.

6. Integrate the functions of the different organelles and cell structures with the overall functioning of the cell.
7. Interpret experimental results and identify consistent and inconsistent elements.
8. Introduce changes in the methods and processes of the field of knowledge to provide innovative responses to the needs and demands of society.
9. Manage information and the organisation and planning of work.
10. Read specialised texts both in English and one's own language.
11. Relate the structure of the different parts of a cell and their functioning.
12. Take responsibility for one's own learning after receiving general instructions.

Content

Unit 1. Introduction: organization of prokaryotic and eukaryotic cells. Main characteristics and differences between prokaryotic and eukaryotic cells.

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

Unit 3. Transport of molecules across the membrane. Simple diffusion and osmosis. Transport of ions and small molecules: passive transport with permeases and with channel proteins; primary and secondary active transport.

Unit 4. The extracellular matrix and the cell wall. The extracellular matrix of animal cells: composition and functions; communication between the cell and the extracellular matrix; diseases related to the extracellular matrix. The cell wall of plant cells.

Unit 5. Junctions and cell adhesion. Cell junctions: occluding, anchoring and channel-forming junctions. Cell adhesion: cell adhesion molecules.

Unit 6. Introduction to intracellular compartments and protein sorting. Cell compartmentation. Intracellular protein sorting.

Unit 7. The nucleus. Nuclear membranes, nuclear lamina and nuclear pores. Bidirectional nucleus-cytoplasm transport: protein import; protein and RNA export. Nuclear matrix. Nucleolus: structure and synthesis of ribosomal RNA. Chromatin: composition and structure; organization of chromatin during interphase; organization and structure of chromosomes.

Unit 8. The cytosol. Composition and organization. Functions: protein folding, post-translational protein modification and processing; protein degradation.

Unit 9. The endoplasmic reticulum. Introduction to the endomembrane system. Structure and composition of the endoplasmic reticulum. Functions of the smooth endoplasmic reticulum: lipid synthesis and cell detoxification. Functions of the roughendoplasmic reticulum: synthesis and translocation of soluble and membrane proteins; protein modifications; quality control.

Unit 10. The Golgi apparatus. Structure and composition of the Golgi apparatus. Basic principles of vesicular transport: types of vesicles, formation and fusion of the vesicles with the target membrane. Vesicular transport between the endoplasmic reticulum and the Golgi and inside the Golgi. Retention of endoplasmic reticulum resident proteins. Modifications of protein oligosaccharides. Metabolism of lipids and polysaccharides. Protein sorting in the trans-Golgi network: transport of lysosomal proteins, constitutive secretion and regulated secretion; retention of Golgi resident proteins.

Unit 11. Endosomes, lysosomes, and vacuoles. Endosomes: structure and composition; classification; function: endocytosis. Lysosomes: structure and composition; obtention of digestion material (autophagy and heterophagy); lysosomal accumulation diseases. Vacuoles in plant cells.

Unit 12. Mitochondria. Structure and composition. Biogenesis: mitochondrial genome and protein synthesis; import of lipids and proteins. Mitochondrial function: cell respiration. Mitochondrial oxidations; electron transport; ATP synthesis; transport across the inner mitochondrial membrane; heat production.

Unit 13. Chloroplasts. Structure and composition. Biogenesis: chloroplast genome; protein import. Chloroplast functions: photosynthesis. Light reactions: light absorption, electron transport and ATP production. Dark reactions: Calvin's cycle, photorespiration.

Unit 14. Peroxisomes. Structure and composition. Biogenesis: import of lipids and proteins; de novo biogenesis. General functions of peroxisomes: oxidative reactions and oxidation of fatty acids. Specific functions of peroxisomes in animal and plant cells.

Unit 15. Microfilaments. Structure and composition. Actin polymerization. Actin binding proteins. Organization of microfilaments in muscle and non-muscle cells. Cell movement.

Unit 16. Microtubules. Structure and composition. Tubulin polymerization. Microtubule-associated proteins. Labile microtubules. Stable microtubules: centrioles, cilia and flagella; structure, biogenesis and functions.

Unit 17. Intermediate filaments. Structure and composition. Polymerization. Intermediate filament-associated proteins. Functions.

Unit 18. Cell signaling. Basic principles of cell signaling. Intracellular receptors. Cell surface receptors: G protein-associated receptors; enzyme-associated receptors. Signal integration.

Unit 19. The cell cycle. Phases of the cell cycle. Cell cycle control: components of the system and checkpoints.

Unit 20. Mitosis. Phases of mitosis and organization of the mitotic spindle. Cytokinesis.

Unit 21. Meiosis. Phases of meiosis. Synaptonemal complex and chromosome synapsis. Genetic recombination.

Activities and Methodology

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Problem-based sessions	4	0.16	1, 2, 3, 4, 5, 6, 7, 8, 11
Theoretical classes	40	1.6	1, 3, 4, 5, 6, 8, 11
Type: Autonomous			
Individual study	52	2.08	3, 4, 5, 9, 6, 10, 11, 12
Problem solving (group work)	25	1	1, 2, 3, 4, 5, 9, 6, 7, 8, 11, 12
Unit preparation (independent-learning work)	25	1	1, 3, 4, 5, 9, 6, 8, 10, 11, 12

This subject consists of theoretical classes and problem-based sessions. The organization and teaching methodology for these two types of educational activities are described below.

Theoretical classes:

The content of the theory programme will be taught mainly in the form of lectures with audiovisual support. Presentations used in class will be previously made available through *Campus virtual*. Although it is not necessary to complement the contents of the classes, unless particularly requested by the lecturer, it is recommended that students regularly consult the works listed in the Bibliography section of this guide in order to consolidate and, if necessary, clarify the content explained in class. In this sense, it is also advisable that students use the web links provided in *Campus virtual*, which contain videos and animations related to the processes explained in class, as well as self-assessment tests that students can take to periodically control their learning process.

In addition to attending classes, students are also required to take an active role during the course, independently preparing some of the units of the programme based on the guidelines provided by the teacher. These guidelines are included in the document titled "*Guia del Treball d'Autoaprenentatge*" (Independent Learning Guide), available on *Campus virtual*. This independent-learning activity can be done either individually or in small working groups. The objectives are that students learn to search, interpret and summarize information gathered from textbooks and other bibliographic sources, and learn to work independently. Questions and doubts that the students may have about the contents of these units will be discussed in class, but only on the dates indicated in the document titled "*Programació de l'assignatura*" (Course Planning), available on *Campus virtual*.

Information collected by students during the independent-learning activities will serve as individual study material, and no work submissions will be required. It is important, however, that students plan their study time according to the course planning in order to have the material prepared in advance of the corresponding problem-based sessions and assessment tests.

Problem-based sessions:

In these sessions, students are divided in two groups. It is compulsory for students to attend the sessions corresponding to their group. Session dates and the set of problems that students will have to solve throughout the course will be available on *Campus virtual*.

During these sessions, students will present solutions to experimental problems related to the contents of the theory programme. This activity aims to serve as consolidation of the contents of the subject, as well as familiarizing students with some of the techniques commonly used in cell biology, the interpretation of scientific data, and the solving of problems based on real experimental situations. In addition, this activity aims to focus on teamwork skills, through the organization of students into working groups in which all group members are required to actively participate.

The methodology of the problem sessions is detailed in the document titled "*Funcionament de les classes de problemes"* (How Problem-Based Sessions Work), available on *Campus virtual*. Briefly, students will organize themselves into groups of four at the beginning of the course and will work on the problems outside class hours. In each problem-based session, the teacher will randomly select a number of students to present their solutions to the problems. The presentations will be assessed by the teacher and the mark obtained by the presenting student will be applied to all members of the group to which that student belongs.

To monitor the proper functioning of the working groups, each student will have to submit two group-assessment questionnaires throughout the course, evaluating their own work and that of the other group members. These questionnaires will be available on *Campus virtual*. Deadlines for submission are indicated in the document titled "*Programació de l'assignatura*" (Course Planning) available on *Campus virtual*.

Students who individually decide not to participate in any group of problems must notify the teaching staff at the beginning of the course, within the established period. These students will be able to attend problem classes but will not participate in the presentations. This option will mean not being able to achieve the maximum grade for the subject (see the Evaluation section of this guide).

For students who participate in problem groups, attendance at problem classes is mandatory. Any absence must be justified and communicated in advance to the teacher.

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.

Assessment

Continous Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
First multiple-choice test: Units 1 to 11 (individual assessment)	35%	1.5	0.06	3, 9, 6, 10, 11, 12
Problem-solving exam 1 (individual assessment)	7.5%	0.5	0.02	1, 3, 4, 5, 6, 7, 8, 11, 12
Problem-solving exam 2 (individual assessment)	7.5%	0.5	0.02	1, 3, 4, 5, 6, 7, 8, 11, 12
Problem-solving oral presentations (group assessment)	15%	0	0	1, 2, 3, 4, 5, 6, 7, 8, 11
Second multiple-choice test: Units 12 to 21 (individual assessment)	35%	1.5	0.06	3, 4, 5, 9, 6, 10, 11, 12

Evaluation consists of continuous assessment, including the following activities:

1. Multiple-choice tests (individual assessment): During the course students will have to take two multiple-choice tests. These tests consist of a series of questions on the corresponding contents of the theory programme, including those units prepared by the students (independent-learning work).

The aim of these tests is to assess that students' acquisition of the subject's conceptual knowledge, their understanding, and their knowledge of how to integrate this information. In addition, by including questions related to the units prepared by the students, the tests also assess students' competence in the management of information (searching for, analyzing, and summarizing information from various sources in order to construct knowledge).

The first test covers units 1-11; the second test covers units 12-21. Each test represents 35% of the final grade. To pass the course, students must obtain a minimum mark of 4 points (out of 10) in each of the two tests.

2. Problem-solving oral presentations (group assessment): Students' presentations in each problem-based session will be assessed by the teacher and the average mark represents 15% of the final course grade. Evaluation will take into account whether students have correctly solved the problem, but will also consider the approach used and how well this has been understood by the presenting student, as well as the quality of the oral presentation. The mark obtained by the presenting student will be applied to all members of the group to which that student belongs.

It is compulsory for each working group to present at least one problem in class and for each member of the group to submit the two group-assessment questionnaires by the established deadlines. Although the results of these questionnaires will not have a specific weighting for the final grade, students with negative ratings from other group members may not receive the mark obtained by their group or may have this mark reduced by half.

Students not submitting the group-assessment questionnaire within the deadline will need to contact the teacher to request an extension within a maximum period of 12 hours after the end of the deadline. If the extension request is accepted, it will be necessary for the students to submit it within the new deadline. Submissions within the extension period will entail a penalty in the final grade of problems of that student

(not of the entire group): 0,5 points will be subtracted from the final grade of the group work for each late-submitted questionnaire. If one of the questionnaires is not delivered, the group work grade will be reduced to 75% for that student, and if none of the two questionnaires is delivered, the group work grade will be reduced to 50%.

Students who voluntarily decide not to participate in any work group will receive a grade of 0 points in this evaluation activity.

3. Problem-solving exams (individual assessment): Together with each of the two multiple-choice tests, students must individually solve a problem, similar to those formulated with the group throughout the course. The mark obtained in each problem represents 7.5% of the final grade.

In order to pass the subject, students must take the two multiple-choice tests and the two problem-solving exams. Students must obtain a minimum mark of 4 in each of the two multiple-choice tests, and a minimum overall grade of 5 for the total assessment activities of the subject.

Students will be graded as "*No Avaluable*" (Not Assessable) if the weighting of all assessable work carried out is less than 67% of the final grade.

Single assessment

Students who follow the single assessment will take the two multiple-choice tests and the two corresponding problem-solving exams jointly on the same date set for the last test of the continuous assessment (second multiple-choice test). The weight of these tests and the reassessment system will be the same as for the continuous assessment.

For problem classes, the same conditions will apply as for students who follow continuous evaluation. Students who take the single assessment may choose to participate in a work group (with mandatory attendance at problem classes) or not to participate (receiving a grade of 0 points in this evaluation activity).

Reassessment

Students with marks lower than 4 in any of the two multiple-choice tests will have to retake the failed test/s. Students who, despite having obtained a mark equal to or higher than 4 points in each of the two tests, obtain an overall subject grade of less than 5 points for the average of all assessment activities will also have to take the reassessment. In this case, the student will have to retake only the multiple-choice test/s with a mark lower than 5 points.

To be eligible for reassessment, students must have previously been evaluated in a set of activities equalling at least two thirds of the final grade for the subject. In the event that the mark obtained in any of the reassessment tests is lower than 4, students will not be able to pass the subject. They will be awarded a final grade of maximum 4 for the subject, regardless of the average grade obtained through the marks from the other assessment activities.

The date of the reassessment test will be the same both for students who follow the continuous assessment and for those who take the single assessment.

Students who, having passed the multiple-choice tests, want to improve their qualification can also retake the tests. Reassessment will imply losing the marks previously obtained. The student's decision to improve their marks must be communicated to the teacher at least one week before the test.

As no minimum pass marks are required for the other assessable activities (problem-solving oral presentations and problem-solving exams), these cannot be retaken.

Repeat students

Students who are repeating the subject may either keep the mark of the group work obtained in the previous year, provided it is $\geq$5, or retake this assessable activity. In either case, these students will need to retake the two problem-solving exams, in addition to the two multiple-choice tests, in order to pass the subject.

Bibliography

Textbooks:

Alberts B, Heald R, Johnson A, Morgan D, Raff M, Roberts K, Walter P, Wilson J. Molecular Biology of the Cell. 7th Edition. W. W. Norton & Company. 2022. ISBN: 978-0-393-88484-5.

Alberts B, Hopkin K, Johnson A, Morgan D, Roberts K, Walter P, Heald R. Essential Cell Biology. 6th Edition. W. W. Norton & Company. 2023. ISBN: 978-1-324-03335-6.

Cooper GM. The Cell: A Molecular Approach. 8th Edition. Oxford University Press. 2019. ISBN: 9781605358635.

Lodish H, Berk A, Kaiser CA, Krieger M, Bretscher A, Ploegh H, Martin KC, Yaffe M, Amon A. Molecular Cell Biology. 9th Edition. Macmillan Learning. 2021. ISBN: 9781319365493.

https://csuc-uab.primo.exlibrisgroup.com/discovery/fulldisplay?docid=alma991010703420806709&context=l

Web links:

Available in Campus Virtual.

Software

Not used.

Language list

Name	Group	Language	Semester	Turn
(PAUL) Classroom practices	311	Catalan	first semester	afternoon
(PAUL) Classroom practices	312	Catalan	first semester	afternoon
(TE) Theory	31	Catalan	first semester	afternoon