Universitat Autònoma de Barcelona

2021/2022

Cell Biology

Code: 103979
ECTS Credits: 6

Degree	Type	Year	Semester
2501922 Nanoscience and Nanotechnology	FB	1	1

The proposed teaching and assessment methodology that appear in the guide may be subject to changes as a result of the restrictions to face-to-face class attendance imposed by the health authorities.

Contact

Name: Marta Martín Flix
Email: Marta.Martin@uab.cat

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

There are no prerequisites for studying Cell Biology. Nonetheless, in order to ensure the achievement of the learning objetives proposed, it is recommended for the students to have achieved a basic knowledge of biology. It is specially important previous knowledge regarding the general structure of eukaryotic cells, their compartments and their organic molecules such as proteins, nucleic acids, carbohydrates and lipids, as well as basic knowledge of the main pathways of cell metabolism.
On the other hand, in a scientific discipline such as Cell Biology where most bibliography and information resources are in English, it is highly recommended that students have at least a basic knowledge of this language.

Objectives and Contextualisation

Cell Biology is taught in the 1st semester of the 1st year of the degree in Nanoscience and Nanotechnology, and also in the same period in other degrees of the Sciences and Biosciences Faculty. Therefore it can be considered a basic subject. The learning objectives the student should achieve are:

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 transport processes through the cell membranes.
5. Describe the structure, composition and function of the different compartments of eukaryotic cells, as well as the relationships between them.
6. Explain the role of mitochondria in cellular bioenergetics.
7. Describe the classification systems and routes of intracellular protein traffic.
8. Describe the composition of chromatin and its organization in interphase and division cells.
9. List the components of the cytoskeleton and describe its composition and structure.
10. Explain the contribution of the cytoskeleton to cell shape and cell movement.
11. Identify and describe the molecules, structures and processes involved in the relationship and communication of the cell with the external environment and with other cells.
12. Identify the molecules involved in the regulation of the cell cycle and explain its function in the cycle control system.
13. List and describe the different phases of the mitotic and meiotic cell division and compare the two types of cell divisions.

14. Relate the functioning of the eukaryotic cell with somediseases.
15. Integrate and apply the theoretical knowledge acquired to interpret the results of simple scientific experiments and to solve simple experimental problems of cell biology.
16. Use the appropriate scientific terminology in the field of cell biology.

Competences

- Apply the concepts, principles, theories and fundamental facts of nanoscience and nanotechnology to solve problems of a quantitative or qualitative nature in the field of nanoscience and nanotechnology.
- Apply the general standards for safety and operations in a laboratory and the specific regulations for the use of chemical and biological instruments, products and materials in consideration of their properties and the risks.
- Be ethically committed.
- Communicate orally and in writing in ones own language.
- Demonstrate knowledge of the concepts, principles, theories and fundamental facts related with nanoscience and nanotechnology.
- Handle the standard instruments and materials of physical, chemical and biological testing laboratories for the study and analysis of phenomena on a nanoscale.
- Interpret the data obtained by means of experimental measures, including the use of computer tools, identify and understand their meanings in relation to appropriate chemical, physical or biological theories.
- Learn autonomously.
- Manage the organisation and planning of tasks.
- Obtain, manage, analyse, synthesise and present information, including the use of digital and computerised media.
- Reason in a critical manner
- Recognise and analyse physical, chemical and biological problems in the field of nanoscience and nanotechnology and propose answers or suitable studies for their resolution, including when necessary the use of bibliographic sources.
- Recognise the terms used in the fields of physics, chemistry, biology, nanoscience and nanotechnology in the English language and use English effectively in writing and orally in all areas of work.
- Resolve problems and make decisions.
- Work on the synthesis, characterisation and study of the properties of materials on a nanoscale from previously established procedures.

Learning Outcomes

1. Be ethically committed.
2. Communicate orally and in writing in ones own language.
3. Correctly observe the protocols for the handling of chemical reagents and biological agents.
4. Critically evaluate basic experimental biological results and deduce their meaning
5. Describe the processes of cellular differentiation, specialisation and death, as well as the cellular bases of pathologies associated to functional errors.
6. Integrate the functions of the different organelles and cell structures with the overall functioning of the cell.
7. Learn autonomously.
8. Manage the organisation and planning of tasks.
9. Obtain, manage, analyse, synthesise and present information, including the use of digital and computerised media.
10. Perform basic synthesis, separation and analysis procedures in a biology laboratory
11. Reason in a critical manner
12. Relate the structure of the different parts of a cell to their functioning.
13. Resolve problems and make decisions.
14. Understand the methodologies used in cellular biology and the knowledge obtained from them, obtain information from biology experiments and interpret the results.
15. Understand the methodologies used in cellular biology and use the knowledge obtained from them to resolve problems.

16. Understand the standard instruments, materials and methodologies used in cellular biology.
17. Use specific bibliographic sources on cellular biology to acquire the information required to autonomously develop and expand the knowledge acquired.
18. Use the correct terminology for biological systems.

Content

CONTENTS OF THE SUBJECT*:

*Unless the requirements enforced by the health authorities demand a prioritization or reduction of these contents.

THEORY LESSONS

Topic 1. Introduction. Organization of the prokaryotic and eukaryotic cells.

Topic 2. Structure and composition of the plasma membrane. Functions, structure and composition of the plasma membrane.

Topic 3. Transport of molecules through the cell membrane. Simple diffusion and osmosis. Transport of ions and small molecules: passive transport through permeases and channel proteins; primary and secondary active transport.

Topic 4. Extracellular matrix. Composition and functions.

Topic 5. Nucleus. Structure, components and bidirectional nucleus-cytoplasm transport. Chromatin: composition, organization and structure.

Topic 6. Cytosol. Composition and structural organization. Functions of the cytosol.

Topic 7. Introduction to the intracellular compartments and the traffic of proteins. Cell compartmentation. Intracellular protein trafficking.

Topic 8. Endoplasmic reticulum. Structure, composition and functions of the rough andsmooth endoplasmic reticulum.

Topic 9. Golgi apparatus. Structure, composition and function of the Golgi apparatus. Basis of vesicular trafficking.

Topic 10. Endosomes, lysosomes. Structure, composition and functions.

Topic 11. Mitochondria. Biogenesis. Structure, composition and functions.

Topic 12. Peroxisomes. Biogenesis. Structure, composition and function.

Topic 13. Microtubules. Structure and composition. Polymerization of the tubulin. Proteins associated with microtubules.

Topic 14. Actin microfilaments. Structure and composition. Polymerization of actin. Actin binding proteins.

Topic 15. Intermediate filaments. Structure and composition. Polymerization Proteins associated with intermediate filaments. Functions

Topic 16. Unions and cell adhesion. Type of cell unions. Cell adhesion: adhesion molecules.

Topic 17. Cell signaling. Basic principles of cell signaling.

Topic 18. Cell cycle. Phases and control of the cell cycle.

Topic 19. Mitosis. Phases of mitosis and organization of the mitotic axis. Cytokinesis.

Topic 20. Meiosis. Phases of meiosis. Sinaptonemal complex and synapse of chromosomes. Genetic recombination.

PRACTICAL LESSONS

Practice 1- Introduction to the optic microscope and the plant cell

Practice 2- The animal cell

Practice 3- Introduction to the electronic microscope

Practice 4- Osmosis and simple diffusion

Practice 5- Mitotic cell division

Practice 6- Meiotic cell division

Methodology

The subject of Cell Biology consists of theoretical lessons, lessons to solve cell biology problems and practical lessons in the biology laboratory*.

*The proposed teaching methodology may experience some modifications depending on the restrictions to face-to-face activities enforced by health authorities.

Theory lessons:
The content of the theory program will be taught mainly by the professor in the form of master classes with audiovisual support. The material used in class by the teacher will be available on the Virtual Campus/Moodle. It is recommended that students download it or print it and bring it to class in order to use it as a support during lessons attendance. Although it is not essential to extend the contents of the lessons (unless explicitly requested by the professor), it is recommended that students consult regularly the books recommended in the Bibliography section of this guide, in order to consolidate and clarify, if necessary, the lessons's contents.

In addition to classes attendance, the follow-up of the subject will also imply an active role of the student, who will autonomously prepare some topics from the theory program based on the guidelines provided by the teacher. The objective of this activity is, on one hand, to encourage the consultation of bibliographic sources and, on the other hand, to allow the students to search, interpret and synthesize information and to work independently. The topics prepared by the students will not be corrected by the professor and will serve as individual study material.

Lessons of cell biology problems:
There will be 4 sessions of cell biology problems. These exercises will be related to the theory program and will be avilable at the Campus Virtual/moodle beforehand. During these lessons, the professor will help the students to solve doubts regarding the resolution of the problems, which will be solved autonomously. The resolution of these exercises has the objective of consolidating theory knowledge. Also, it will provide the means for the student to become familiar with some of the techniques used in cell biology research, with the interpretation of scientific data and with the resolution of problems based on real experimental situations.

Students must have solved the exercises autonomously before the lesson, since these sessions will serve to solve doubts, not to solve the excercises.

The individual ability of each student to efficiently solve a scientific problem will be evaluated in the second partial test, where they will have to solve a problem similar to those analysed during the lessons throughout the semester. The mark obtained from the resolution of the cell biology problem will contribute to the final mark of the subject.

Practical lessons:
The practical lessons are designed for the students to complement the theoretical concepts and to learn to use the instrumental of the cell biology laboratory, especially the optical microscope. The students will attend 6 practical lessons of 2 hours each. The students will work in groups of two and, at the end of each practical lesson, they will have to complete a questionnaire individually. The marks from all the questionnaires will be averaged and will contribute to the final grade of the subject.

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.

Activities

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Cell biology problems	4	0.16	7, 4, 2, 5, 8, 6, 1, 9, 11, 12, 15, 14, 13, 18, 17
Practical lessons	12	0.48	4, 2, 5, 10, 8, 6, 1, 11, 16, 12, 14, 3, 18
Theory lessons	36	1.44	7, 2, 5, 8, 6, 1, 9, 11, 12, 18, 17
Type: Autonomous			
Individual study	58	2.32	7, 5, 8, 6, 1, 9, 11, 12, 18, 17
Prepare theory topics autonomously	20	0.8	7, 5, 8, 6, 1, 9, 11, 12, 18, 17
Solving cell biology problems	10	0.4	7, 4, 5, 8, 6, 1, 9, 11, 12, 15, 13, 18, 17

Assessment

EVALUATION ACTIVITIES
This subject, which will be evaluated continuously throughout the semester, will consist of the following evaluation activities*:

*Student's assessment may experience some modifications depending on the restrictions to face-to-face activities enforced by health authorities.

1. Theoretical part:
It will represent 70% of the final mark. There will be 2 partial tests and each of them will weight 35% on the final grade. The first test will be performed when approximately half of the theoretical lessons have been taught. The second test will be performed at the end of the theoretical lessons.

Although each partial test will evaluate different lessons, the second partial test may also include, indirectly, theory contents of the first one.

In order to obtain an average mark from the 2 partial tests, the mark of each partial test must be ≥ 3.5.

Students who do not take any of the partial tests or do not reach the minimum mark after taking any of them, can take the make-up test.

Problem of cell biology:
The student will solve a problem individually during the 2nd partial test and it will represent 10% of the final mark. Students who do not take the 2nd partial test will be able to solve a cell biology problem during the make-up test.

3. Practical lessons:
At the end of each practical lesson the student will solve a questionnaire. The average mark of the 6 questionnaires will be the practical mark and it will represent 20% of the final mark.

Attendance to the practical lessons in the biology laboratory is mandatory. Failure to attend one practical lesson without justification will result in the reduction of the average mark of the questionnaires to 75%. Non-attendance to two practical lessons without justification will imply a 50% reduction. In case of not attending three or more practical lessons without justification the student will not be able to pass the Cell Biology subject.

In order to attend practical lessons, students must justify having passed the biosafety and safety tests foundon the Virtual Campus and guarantee their knowledge and accept the rules ofof the laboratories of the Faculty of Biosciences.

EVALUATION

In order to obtain the maximum mark in Cell Biology, the students will have to perform:

- The two partial written tests: (35% + 35%) or, in case of not passing them, the make-up test (70%).

  - In order for the 2 partial tests to average, the mark of each partial test must be $\geq$ 3.5.
  - When a mark below 3.5 in a partial test is obtained, the student can attend the make-up test to re-take the failed partial test/s.

- Solve a problem individually (10%) either during the second partial test or during the make-up exam.
- Have attended the practical lessons and solved the corresponding questionnaires (20%).

To be ableto pass the subject, students must obtain a score of $\geq$5 points (out of 10) in the overall average of all these tests.

Other general considerations:

-Students that have not attended the partial tests without a justified reason CANNOT attend the make-up test.
- Those students who attend less than 60% of the scheduled evaluation activities will be considered as NOT EVALUATED. Evaluation activities are: i) any partial test to evaluate the theoretical contents; ii) the whole set of practical lessons; iii) individual resolution of a problem. If a student attends $\geq$3 of these activities, a mark will be introduced in the student's file.
- In case a student fails the theoretical part of the subject but passes the practical part (obtaining a minimum of 5 points out of 10), this mark will be saved during a period of three additional tuition fees.
- The mark obtained from solving a cell biology problem will not be saved for the following years.
- Students who can not attend a test for a justified reason (such as: health problem, death of a first- or second-degree relative, accident, mandatory activity or competition in the case of elite athletes, etc.) and deliverthe official documentation (official medical certificate that explicitly certify the inability to attend an examination, police attestation, justification of the competent sport authority, etc.) to the professor and the coordinator of the degree, will have the right to take the test on another date. The coordinator of the degree, along with the professor will provide another examination date to the student.
- Students who have passed both partial tests will have the opportunity to IMPROVE the MARK of the theoretical part if they wish to do so taking the make-up exam of the whole subject. At least 3 days before the make-up exam, the student will write an email to the professor informing thatthey resign from the the already attained mark. The final mark, that will be used to evaluate the student, will be that obtained in the last test (make-up test).

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
First partial test (theory lessons)	35%	2	0.08	7, 2, 5, 6, 1, 9, 11, 12, 18, 17

Make-up test (theory lessons)	70%	4	0.16	7, 2, 5, 6, 1, 9, 11, 12, 18, 17
Practical lessons	20%	1	0.04	4, 2, 5, 10, 6, 1, 11, 16, 12, 14, 3, 18
Second partial test (theory lessons)	35%	2	0.08	7, 2, 5, 8, 6, 1, 9, 11, 12, 18, 17
Solving of a cell biology problem (individually)	10%	1	0.04	4, 2, 5, 6, 1, 9, 11, 12, 15, 14, 13, 18, 17

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• Lodish H, Berk A, Kaiser CA, Krieger M, Scott MP, Bretscher A, Ploegh H, Matsudaira P. Molecular Cell Biology. 6th Edition. WH Freeman and Company. New York, 2007.
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• Paniagua R, Nistal M, Sesma P, Álarez-Uría M, Fraile B, Anadón R, Sáez FJ. Cell Biology. 3rd Edition. McGraw-Hill Inter-American of Spain S.L.
Part of the content of some of the books listed in the bibliography can be consulted online:
Cooper: http://www.ncbi.nlm.nih.gov/bookshelf/br.fcgi?book=cooper
Alberts: http://www.ncbi.nlm.nih.gov/bookshelf/br.fcgi?book=mboc4
Lodish: https://www.ncbi.nlm.nih.gov/books/NBK21475/?term=lodish
Website where you can access simple animations showing many of the basic cellular processes:
http://www.johnkyrk.com/index.esp.html

Software

There are no specific requirements of programs / software in this subject.