Cell Biology

Code: 107541
ECTS Credits: 6

2024/2025

Degree	Type	Year
2500502 Microbiology	FB	1

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Teaching groups languages

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

Prerequisites

Sufficient knowledge of Biology during secondary school.

Erasmus students should consider that lessons are taught in Català.

Objectives and Contextualisation

This is a compulsory first-year course that introduces students to the fundamentals aspects of cell biology. The central object of study of Cellular Biology is the eukaryotic cell, the knowledge of intracellular molecules and the interactions between cells that allow the construction of multicellular organisms.

The specific objectives are:

• Recognize the structural and compositional differences of prokaryotic and eukaryotic cells.

• Demonstrate how the architecture - composition, structure, dynamism - of biological membranes affects the functionality of the cell and its compartments.

• Describe the structure, composition and function of the different compartments/organelles of eukaryotic cells, as well as the existing relationships between them.

• Define the different components of the cytosol and determine their role in the biogenesis, intracellular traffic and degradation of proteins.

• Identify the different components of the cytoskeleton based on their composition and structure and explain their contribution to cell shape and movement.

• List and describe the different phases of mitotic and meiotic cell division, and determine their main components, their regulation, as well as their similarities and differences.

• Perform basic calculations to determine biological parameters.

• Apply basic laboratory techniques to plan and test small experiments with eukaryotic cells.

• Integrate and apply the theoretical knowledge acquired to interpret the results of simple scientific experiments and to solve experimental problems in cell biology.

• Use the appropriate scientific terminology in the field of cell biology.

Learning Outcomes

1. CM06 (Competence) Integrate knowledge and skills from the field of biology, working individually and in groups, to prepare and present in writing or orally and publicly a scientific work.
2. KM08 (Knowledge) Define the structure, organization and functioning of the different types of cells, tissues and physiological systems in living organisms.
3. KM10 (Knowledge) Identify the structure and organisation of genetic material and the mechanisms of biological inheritance.
4. SM06 (Skill) Relate the main biophysical, cellular, molecular and biochemical bases of physiological systems with their functioning.

Content

I. GLOBAL VISION OF THE CELL

Unit 1. The cell. The origin of the cell. From prokaryotes to eukaryotes. Organization of the prokaryotic and eukaryotic cell.

Unit 2. Visualization of cells and their components. Microscopy. Detection of molecules in dead and living cells.

II. CELLULAR SURFACE

Unit 3. Structure and composition of the plasma membrane. Functions, structure and composition. Characteristics of the membrane: fluidity and asymmetry. Occluding junctions (Tight junctions).

Unit 4. Transport of molecules through the membranes. Simple diffusion. Transport of ions and small molecules: Passive transport and active transport. Communicating junctions: Gap and plasmodesmata.

III. COMPARTMENTS OF THE EUKARYOTIC CELL

Unit 5. Introduction to intracellular compartments and the cytosol. Cell compartmentation. Protein intracellular traffic. Composition and organization of the cytosol. Protein folding, post-translational modifications, protein processing and degradation.

Unit 6. Endoplasmic reticulum. Introduction to the endomembrane system: structure and composition. Functions of the smooth endoplasmic reticulum: synthesis of lipids. Functions of the rough endoplasmic reticulum: protein synthesis,protein modifications and quality control. Vesicular transport between the reticulum and the Golgi apparatus. Recovery of endoplasmic reticulum resident proteins.

Unit 7. Basic principles of vesicular transport. Type of vesicles, vesicle formation and fusion with the target membrane.

Unit 8. Golgi apparatus and secretion routes. Structure and composition of the Golgi apparatus. Glycosylation and modification of protein's oligosaccharides. Distribution of proteins in the trans-Golgi network: transport of lysosomal proteins, constitutive secretion and regulated secretion. Retention of Golgi apparatus resident proteins.

Unit 9. Routesof endocytosis. Endosomal compartment: structure, composition and classification. Endocytosis (pinocytosis and phagocytosis). Lysosomes: structure and composition. Digestion of material (autophagy and heterophagy) and genetic defects in acid hydrolases.

Unit 10. Mitochondria. Structure and composition. Biogenesis: mitochondrial genome and protein synthesis; import of lipids and proteins. Functions of mitochondria: oxidations, electron transport and ATP synthesis; transport through the internal mitochondrial membrane and heat production.

Unit 11. Chloroplasts. Structure and composition. Biogenesis: chloroplast genome; protein import. Functions of chloroplast: Photosynthesis. Light reactions: absorption of light, transport of electrons and production of NADPH and ATP. Dark reactions: Calvin's cycle and photo-respiration.

Unit 12. Peroxisomes. Structure and composition. Biogenesis: import of lipids and proteins; genetic diseases related to deficient protein import. General functions of peroxisomes: oxidative reactions and oxidation of fatty acids. Specific functions in animal cells: detoxification reactions and synthesis of plasmalogens and, in plant cells: photorespiration and glyoxylate cycle.

Unit 13. Nucleus. Nuclear envelope, nuclear lamina and pore complex structure. Bidirectional transport between nucleus-cytoplasm. Nucleolus: structure and synthesis of ribosomal RNA. Chromatin: composition and structure and DNA heterogeneity. Organization of chromatin in theinterphase nucleus: euchromatin and heterochromatin. Organization and structure of the chromosome.

IV. CYTOSKELETON AND CELL MOVEMENT

Unit 14. Microfilaments. Structure and composition. Actin polymerization. Actin binding proteins (ABPs). Organization of microfilaments in muscle and non-muscle cells. Cell movement. Adherens junctions: adhesion belt and focal adhesions.

Unit 15. Microtubules. Structure and composition. Polymerization of tubulin. Proteins associated with microtubules (MAPs). Labile and stable microtubules. Centrioles, cilia and flagella: structure, biogenesis and functions.

Unit 16. Intermediate filaments. Structure and composition. Polymerization. Proteins associated with the intermediate filaments (IFAPs). Associated functions. Adherent junctions: Desmosome and Hemidesmosome.

V. THE VITAL CYCLE OF THE EUKARYOTIC CELL

Unit 17. Cell cycle and Mitosis. Phases of the cell cycle. Control of the cell cycle: system components and checkpoints. Phases of mitosis and organization of the mitotic spindle. Cytokinesis.

Unit 18. Meiosis. Phases of meiosis. Synaptonemal complex and synapses of the chromosomes. Genetic recombination.

Activities and Methodology

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Lectures	40	1.6	KM08, KM10, SM06, KM08

Scientific Problems	6	0.24	CM06, SM06, CM06
Type: Autonomous			
Scientific problems solving	30	1.2	CM06, SM06, CM06
Self-study units preparation	15	0.6	KM08, SM06, KM08
Study	55	2.2	KM08, KM10, SM06, KM08

The subject will be taught following the guidelines imposed by the Convergence process towards the creation of a European Higher Education Area (EHEA), endorsed by the Bologna Declaration (1999). Basically, this implies a more active participation of students in their own learning process, which translates into greater participation of students in class, more interaction among students and of these with the teacher. In addition to classroom-based (lectures) methodology, the learning process is completed through remote activities during the school term that translates into an important weight of the final grade of the subject. Teaching methodology and modalities are described as follows:

Lectures

The content of the theory program will be taught mainly by the teacher in the form of master classes. The theoretical classes will be complemented by the visualization of animations and videos related to the subjects covered in class. Teacher's presentations will be available in *pdf format in the Moodle platform. It is recommended that students take this material to class to use as support when taking notes. Although it is not essential to extend the contents of the classes taught by the teacher, unless it is specifically requested, students are advised to consult the books recommended in the Bibliography section on a regular basis to consolidate and clarify, if necessary, the contents explained in class.

In addition, the follow-up of the course also implies an active role of the students, through the preparation of some of the Units of the program. At the beginning of the course, the student will be provided with a list of the sections to be prepared and a detailed script of the aspects and contents that must be developed for each one of them. The detailed description of the contentsthat students must prepare will be collected in the form of a Self-Learning Work Guide, available in Moodle. The preparation of these Units by the students will help them to achieve their skills in individual or group work. It is intended that students acquire the ability to seek information from different sources and synthesize all the information collected; as well as being responsible and independent in the study of a subject.

Scientific problems Sessions

The resolution of scientific problems allows to carry out a very interesting deduction and integration exercise for the scientific training of the students. Therefore, the theoretical knowledge is complemented with the resolution of 20 problems related to the Units covered in class. Thus, these classes involve an integration of concepts and knowledge that let the student know its level of learning and are a way of approaching the student to the scientific method.

The proposed problems, the response template as well as a delivery guidelines will also be found in the Moodle platform. To solve the problems, students should form groups of four people that will meet outside of the class hours. At the beginning of the course the students will organize themselves to arrange the groups *via* the Moodle platform.

The problems will then be discussed and corrected in class requiring the active participation of the students. A student will be asked, at random, to present the resolution of a problem and explain it to the rest of the classmates.This presentation will be evaluated by the teacher and the students through an online questionnaire. The evaluation rubric will be available in the Moodle platform in pdf format.

Finally, students will be asked to answer two questionnaires about teamwork (one in the middle and the other at the end of the problems sessions). The information collected in these questionnaires will be considered to

verify and modulate, if necessary, the mark of the group work of each student. Scientific problems session's attendance is mandatory (the name of the students attending will be recorded). If a session of problems is missed in an unjustified way -medical cause- there will be a penalty in the corresponding mark of the module.

Tutorials

The tutorials will be carried out in a personalized way in the teacher's offices at arranged hours. The students should contact to the teacher at class or by e-mail to schedule a meeting. The tutorials should be used to clarify concepts, settle the knowledge acquired and facilitate the study by students. They can also be used to solve doubts that students have about the preparation of self-learning work, or the course in general.

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
Scientific Problems (team work)	13%	0	0	CM06, SM06
Scientific problem I	6%	0.5	0.02	CM06, SM06
Scientific problem II	6%	0.5	0.02	CM06, SM06
Writen test 2	37,5%	1.5	0.06	KM08, KM10, SM06
Written test 1	37,5%	1.5	0.06	KM08, KM10, SM06

The evaluation of academic achievements is not simple and must take into consideration whether a level of knowledge, skills, abilities and critical maturity has been acquired in accordance with the previously established objectives. This evaluation process involves different levels of assessment: (i) student's abilities towards assimilated information, (ii) student's comprehension and its ability to relate and integrate with other knowledge, (iii) determine whether the student understands and is able to apply the methodologies and techniques acquired during the semester, and, finally, (iv) determine if students can solve experimental problems.

The evaluation of the competences of this subject will be organized in two itineraries: (1) Continuous evaluation and (2) Single evaluation and within each itinerary there will be 2 sections, each one of which will be assigned a specific weight in the final qualification:

(1) Continuous evaluation (CE)

Written tests-theory (75% of the global mark): In this section, the scientific knowledge reached by each student, as well as its capacity for analysis and synthesis, and for scientific reasoning is evaluated. The individual evaluation of the theoretical concepts studied will be carried out through two written tests throughout the course (see the syllabus of the subject) with a weight of 37,5% each.

Scientific problems-PAUL (25% of the global mark):

- 13% will correspond to the evaluation of the public presentation of the resolution of problems in the classroom by the students and teamwork. The grade of each group of students will be calculated by taking the arithmetic average of the sum of the grades obtained in the oral presentations of each member. This mark will be shared by all members of the group and will be equivalent to 11% of the final mark. At

the same time, it will be taken into account that each student has answered and handed in the 2 questionnaires corresponding to teamwork (2%) on the established date.
The grade obtained in this block can be modulated individually, depending on the questionnaire and attendance at classes. Attendance at problem class is mandatory (list will be passed in class). In the event of unexcused absences from class due to problems, there will be a penalty in the final grade: absence 1 session = reduction of 10% of the grade. See reasons for justified cause in the Evaluation Criteria of the Faculty of Biosciences (Permanent Board Agreement of March 29, 2023).

- The remaining 12% of the overall mark will come from the individual resolution of a scientific problem, similar to those worked on in class, on the day of the written test I (6%) and on the day of the written test II (6%).

- IMPORTANT: The grade for the scientific problem block of that student who misses more than one session of PAUL, justified or not, will be given solely for the individual resolution of the scientific problems on the day of the written test I and II. Each of these problems will have a weight of 12.5% of the overall grade (Total scientific problems = 25% overall grade).

(2) Single Evaluation (SE)

Written tests - theory (75% of the overall mark): In this section, the theoretical concepts of the entire program will be evaluated in a single synthesis exam that will coincide with the same date set for the written test II of continuous assessment.

Scientific problems (25% of the global mark): Two possible circuits are foreseen: a) Students who attend PAUL and participatein group work. The evaluation, in this case, will be equivalent to the corresponding part of the continuous evaluation (CE); b) Students who do not attend PAUL and do not participate in group work. These students will have to solve two scientific problems individually on the day of the synthesis test. Each of these problems will have a weight of 12.5% of the overall grade (Total scientific problems = 25% overall grade).

To pass the subject, it is essential to obtain a minimun rating of 4,5 (out of 10) in the written tests-theory (75% of the global mark) and a final mark equal to or greater than 5 points (out of 10) after weighting all the sections (written tests + scientific problems).

Recovery Activities

Students who initially do not pass the subject through CE/SE can be eligible for the retake process. However, to participate in the recovery, students must have been previously evaluated in a set of activities whose weight is equivalent to a minimum of two thirds of the subject (67%). In summary, the recovery will consist of a multiple choice exam, which will evaluate the achievement of the training objectives corresponding to the written-theory tests. All those activities corresponding to scientific problems are excluded from the recovery process. The different assumptions to appear for recovery may be:

- That the grade ofthe written tests I and/or II (CE) is less than 4.0 (out of 10).

- That the score obtained after weighing the written tests (CE) or single synthesis (SE) does not reach 4.5 (out of 10).

- That the weighted average of written tests + scientific problems is less than 5 points (out of 10).

In addition, those students who - having passed the subject through CE/SE - want to present themselves to upload a grade, may do so if they inform the teacher in advance. In this context,the students renounce the qualification obtained previously in the corresponding tests.

Global Considerations of the Subject

A student will be considered as "Non-evaluated" when the assessment activities performed have a weight lesser than 67% in the qualification of the final score of the course or module.

Students who do not pass the subject will be kept the grade they obtained in the problem classes (13% overall of the overall grade) and will be exempt from attending these classes. In the event that this grade is to be improved, the student must attend the problem classes again or must expressly inform the subject coordinator that 25% of the overall grade for the scientific problems will come solely from the individual resolution of the two scientific problems on the day of the written test I and II. Each of these problems will have a weight of 12.5% of the overall grade (Total = 25% overall grade).

NB: This text has not been proofreading by a native English, so in case of any doubt or incongruity, the information provided in the Catalan/Spanish version will prevail.

Bibliography

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The contents of some books can be consulted online at NCBI, at the following address: http://www.ncbi.nlm.nih.gov/sites/entrez?db=Books&itool=toolbar.

Software

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Language list

Name	Group	Language	Semester	Turn
(SEM) Seminars	711	Catalan	first semester	morning-mixed
(SEM) Seminars	712	Catalan	first semester	morning-mixed
(TE) Theory	71	Catalan	first semester	afternoon