Universitat de Lleida

DEGREE CURRICULUM

CELLULAR BIOLOGY

Coordination: ENCINAS MARTIN, MARIO

Academic year 2022-23

CELLULAR BIOLOGY 2022-23

Subject's general information

Subject name	CELLULAR BIOLOGY
Code	101503
Semester	PRIMER QUADRIMESTRE
Typology	

Degree	Course	Character	Modality
Bachelor's Degree in Biomedical Sciences	1	COMMON/CORE	Attendance-based

Course number of credits (ECTS)	7.5
Type of activity, credits, and groups	

Activity type	PRALAB	PRAULA	TEORIA
Number of credits	2	1.4	4.1
Number of groups	3	2	1

Coordination	ENCINAS MARTIN, MARIO
Department	EXPERIMENTAL MEDICINE
Teaching load distribution between lectures and independent student work	Attended classes75h Personal work 112,5h
Important information on data processing	Consult this link for more information.
Language	Català
Distribution of credits	Theoretical class 41 Seminars 14 Laboratory Practices 20 h Tutorial activities 6 h

Teaching staff	E-mail addresses	Credits taught by teacher	Office and hour of attention
ENCINAS MARTIN, MARIO	mario.encinas@udl.cat	5,6	
LLOVERA TOMAS, MARTA	marta.llovera@udl.cat	2,4	
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Subject's extra information

Cell Biology is a fundamental subject in the training of graduates in Biomedicine (Biomedical Sciences) for the contributions of the Cell world in the knowledge of the functioning of the human body and in deciphering of the cellular and molecular bases of diseases. In this subject we want to provide to students, who begin the studies of the degree of Biomedicine (Biomedical Sciences), the basic and necessary knowledge that allow them to understand the cellular processes responsible for the functioning of the human body and the cellular bases to allow us the understand the causes and origin of diseases. One of the goals is that students could learn about the use this knowledge to design experimental models and interpret the most prevalent and current human pathologies in our society such as Cancer, Neurodegeneration, Aging and Metabolic and Cardiovascular Diseases, applying the knowledge and scientific language achieved with Cell Biology

In addition, the purpose of this subject is to facilitate the acquisition of basic transversal skills, terminological skills and the basic concepts of Cell Biology, both structurally and functionally level. A good knowledge of this subject is essential to be able to deepen, further, in the Human Pathophysiology, the Cellular Pathology, the Physiology and in subjects of Pathology of courses superiors.

At the methodological level, we want to familiarize students with the techniques and devices classically used in the study of cells at the morphological level, and will also collaborate with the acquisition of more transversal skills as are the ability to communicate or to carry out teamwork and using TICs for obtaining and managing scientific information.

In order to facilitate a right follow-up of Cell Biology as subject, it is advisable that students have previously took Biology, at the high school and the optional subject Human Biology.

The current health situation may make us work in a very different way from the traditional one, where telematic tools and tutorials, both face-to-face and non-face-to-face, will play a very important role. That’s why you need to become familiar with the UDL Virtual Space, a tool that will be key in this academic year. However, we hope that this course can be developed properly and follow the established schedule.

Gradually we will inform you about the different activities and how they will be developed

Unforeseen situations may arise during the course that will be addressed according to their complexity, although we expect the course to develop as scheduled. However, we hope that this course can be developed properly and follow the established schedule.*entific language achieved with Cell Biology*

Learning objectives

1) At the knowledge level the student to pass the subject must:

- *The student should know and be able to apply the specified concepts and the acquired with the theoretical program.*
- *The student should know how to use cellular concepts to interpret morphofunctional aspects of the human body and its pathology.*

2) The main teaching objectives to be achieved with the scheduled activities are:

- *Know, identify and interpret microscopically different types of cells both in terms of optical and electron microscopy.*
- *Apply microscopy techniques in experimental designs*
- *Know the molecular organization and functional aspects of different organelles and cell compartments. In addition, students must know how to apply this knowledge in the interpretation of pathophysiological situations.*
- *Develop their critical and scientific capacity*
- *Be able to present in public a scientific work elaborated from different sources of information*

3) In addition, the student who passes the subject must achieve the following competencies:

- *Know how to use the optical microscope correctly and know the microscopes most used in Biomedical research.*
- *Know how to perform and apply the microscopy techniques used in the preparation of samples to be observed in different types of microscopes •*
- *Be able to interpret microphotographs of electron microscopy.*
- *Use correctly the basic technological environment in which training will take place (Virtual campus, e-mail, scientific databases and sources of information.) And handle general computer packages at the user level.*
- *Acquisition of self-training habits:*
- *Search, select and process information related to the subject using ICT.*
- *Show regular habits of sustainable study*
- *Know how to extract the most relevant aspects of a scientific text, make a summary and present it to classmates*
- *Work as a team in problem solving and hypothesis making*

Competences

Recognize the structure and function of animal cells, as well as their life cycle, and the mechanisms that regulate it, and acquire an integrated view at the molecular, structural and functional level of cell structures and their alterations in relation to human pathology

Manage and apply the microscopic methods used in biomedical research

Critically evaluate and use clinical and biomedical information technologies and sources to obtain, organize, interpret and communicate clinical, scientific and health information

Use laboratory material and apply basic laboratory techniques

Identify the indications for biochemical, hematological, immunological, microbiological, anatomopathological and imaging tests

That students have demonstrated that they have and understand knowledge in an area of study that is based on general secondary education, and is usually found at a level that, while supported by advanced textbooks, also includes some aspects that involve knowledge from the forefront of their field of study

That students know how to apply their knowledge to their work or vocation in a professional way and possess the skills that are usually demonstrated through the development and defense of arguments and problem solving within their area of study

Subject contents

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Topic 1. The cellular world and its diversity. The Cell Theory.

Levels of organization in the living organisms. Molecular level: macromolecules, viruses and cell organelles. Cell types: prokaryotic cell, eukaryotic cell. Cell theory and its consequences in the organization of the body and disease origin. Cell level: cell size, cell diversity. Cell diversity in the human body. Cell specialization: functional significance, cell integration into tissues. Stem cells. Cell and disease.

Topic 2. The cellular environment in multicellular organisms. The extracellular matrix (ECM).

Accellular elements of our body, the extracellular matrix (ECM). The Matrisoma. Molecular organization, fibrous elements: collagen and its diversity and elastin. Amorphous ground substance: proteoglycans and glycosaminoglycans, adhesion proteins. Extracellular vesicles. Types of MEC: the basal lamina. Interaction of cells with MEC: cell migration and tissue repair. Biomaterials obtained from MEC and used in regenerative medicine. Other kind of non-collagenous extracellular matrices: the biofilm

Topic 3. Biological membranes.

Diversity of cell membranes. Membrane insulation for study. Composition and molecular organization of lipid membranes, bilayers and monolayers lipidic. Liposomes, solid lipid nanoparticles. Membrane lipids: phosphoglycerides, sphingolipids, terpenoids and cholesterol. Membrane proteins: integral, peripheral and lipid-anchored. Glycocalyx. Properties of membranes due to their lipid composition: fluidity, asymmetry, microdomains and polarity of membranes Functions of the plasma membrane.

Topic 4. Molecular transport through biological membrane

Membrane permeability. Passive diffusion and active diffusion: free diffusion and facilitated diffusion by channels or transporter proteins Electrical properties of membranes. Movement of a water across cell membranes: osmosis and aquaporins. Active transport, transporter proteins: pumps, ABC transporters, antiporter and symporter. Diseases related to dysfunctions of solutes transport across membranes

Topic 5 Macromolecular membrane transport.

Mechanisms of vesicular transport: endocytosis, exocytosis and extracellular vesicles. Receptor-mediated endocytosis: Clathrin-mediated endocytosis, coated pits, clathrin-coated, caveolae, adaptins, endosome. Transport across the membrane of cholesterol, immunoglobulins and iron. Exosomes, microvesicles, and friends. Endocytosis machinery as infection strategy used by viruses and bacteria.

Topic 6. Cell adhesion: Cell junctions

Cell adhesion and its role in tissue formation. Cell adhesion molecules: cadherins, integrin, immunoglobulin superfamily and selectins. Cell junction related to the cell-to-cell and the cell-to-MEC contact. Relationship of cell junctions with the cytoskeleton. Cell adhesion and cellular signalling pathways. Adhesion in cell migration during tissue repair and tumour development and dissemination. Diseases related to the cell adhesion

Topic 7 Cellular, molecular and physiological aspects of cell communication.

Models of intercellular signalling, receptors and signalling molecules, second messengers, phosphorylation and dephosphorylation. Signalling components, cell surface receptors: Ion channel-linked receptors, trimeric G proteins, enzymatic receptors; protein kinase. Intracellular signal receptors. Intracellular signal transduction and signalling pathway, SH2, PTB, RAS domains.

Topic 8 Structures and non-membranous elements of the cytoplasm.

The hyaloplasm, viscosity phases: Sol and Gel. Storage inclusions, molecular organization and regulation: glycogen granules, lipid droplets. The ribosome. The proteasome

Topic 9 Cytoskeleton-I, Molecular organization.

Cytoskeleton as scaffolding of animal cells, Molecular structure and organization: Microtubules, microfilaments, intermediate filaments (FI). Cytoskeleton dynamics: polymerization and depolymerization. The cell shape and cytoskeleton: the microvilli, centrioles and the polarity of cells, centrosomes. Cell adhesion and cytoskeleton

Topic 10 Cytoskeleton-II, Cell Motility.

Cell movement and cytoskeleton. Polarity of cytoskeleton elements. Motor proteins. Cell movement: Cilia and flagella, the sarcomere, cytoplasmic vesicular traffic related to the cytoskeleton

Topic 11 The mitochondria. Energy conversion.

Mitochondrial shape and diversity. Morphofunctional aspects of the mitochondria: The outer membrane, VDAC, mitochondria-associated ER membrane (MAM). The inner membrane: cell respiration, electron transport chain, energy conversion, ATP synthase complex. Heat production and thermogenesis. Other mitochondrial functions: Fe-S complex synthesis, regulation of apoptotic death. The mitochondrion as an autonomous organelle: genome and maternal inheritance, machinery for mitochondrial protein synthesis. Cytoplasmic protein imports: TIM and TOM. Mitochondria-derived organelles: mitosome, hydrogenosome. Dysfunction disease and ageing.

Topic 12 The peroxisome.

Morphofunctional aspects: oxidation of organic compounds, oxidases and catalases. Metabolic functions; detoxification, lipid synthesis and oxidation: alpha and beta-oxidation. Biogenesis of peroxisomes: peroxins, PTS, peroxisome assembly. Peroxisomal disorders

Topic 13 Endomembrane system. Intracellular compartmentalization of the secretory pathway.

Components of the system. Rough endoplasmic reticulum: Morphofunctional aspects, secretory protein synthesis, lipid synthesis, glycoconjugate synthesis. Smooth endoplasmic reticulum, metabolic processes and detoxification. The sarcoplasmic reticulum and calcium dynamics. Golgi complex: Morphofunctional aspects. Intracellular vesicular transport: COPs, SNARE, adaptins, exocytosis. Vesicular intracellular digestion. Endosomal system, proton pumps. The lysosome, break down biomolecules. Autophagy, relationship with cancer. Multivesicular bodies. Response of cells to unfolded proteins

Topic 14 Cell nucleus

Nucleus and eukaryotic cell. Nuclear diversity. Organization: Nuclear envelope, nuclear lamina, nuclear pore, nucleocytoplasmic exchanges, nuclear virus egress. Chromatin, composition and levels of organization: histones and their modifications, nucleosome, 30 nm fibre, loops, lampbrush chromosomes. Spatial and functional organization of nuclear chromatin: Euchromatin, heterochromatin and its heterogeneity, the X chromosome. Specialized regions of the nucleus: nucleolus, Cajal bodies, speckles.

Topic 15. Cell cycle.

Phases of the cell cycle. Methods for cell cycle study. Control of cell cycle: Checkpoints, MPF and Xenopus laevis. Cyclins and cdks: functions and regulation. P21, p53 and retinoblastoma proteins. Role of the proteasome in the regulation of the cell cycle. Cell division

Topic 16 Cell death

Cell death theories. Programmed cell death, apoptosis. Functional aspects of death during development and their importance in homeostasis. Morphological and molecular bases: apoptotic bodies, apoptosome, caspases. Genetic control of apoptosis in C. elegans and mammals. Apoptosis Vs. necrosis

Topic 17. Cellular bases of regenerative medicine.

Tissue regeneration in different organisms. The regeneration of human tissues. Stem cells: adult and embryonic. Stem-cell therapy. Induced stem cells (iPS)

Topic 18 Methods of study and research in Cell Biology (Practices).

Methodology

Teaching methodology used in the academic course for the subject of Cell Biology.

Theoretical classes

These will be done with all students in the classroom

Their purpose is to give a subject overview, highlighting those aspects that will be useful to them in their training as Biomedical scientific

Seminars. (Sem)

The purpose of seminars is that students learn to apply the theoretical concepts to solve problems and to delve into these most relevant and complex aspects of Cell Biology

Virtual activities. (Av)

The virtual training activities will take place through the UdL Virtual Campus platform (Sakai). Using this platform and its tools, various training activities related to the preparation of thematic contents, application of concepts and teamwork and work will be done.

Tutorials. (Tut)

It is a training activity designed to be carried out as a closing of a group of related topics. Its purpose is to go through the thematic contents, guide learning to avoid conceptual dispersion, clarify doubts and, finally, establish a conceptual diagram.

Computer classroom activities. (A Inf.)

Students will do some computer practices in order to apply and work on some theoretical concepts.

Laboratory Practices (L.P)

The aim of the laboratory practices, as a training activity, is for students to become familiar with basic microscopy techniques, learn how to use the microscope, know the different types of microscopes and their use, learn to prepare samples and know how to apply different staining methodologies.

Development plan

Due to the current complexity we are experiencing, the programming and the evaluation system of the guide can change, adapting to new situations. If this was the case, the changes to the programming will be communicated through the virtual space, one week before beginning the course, changes to the schedule will be indicated, in relation to the original, to start the course as normal.
Following the programming guidelines:
• Initially, and for each of the topics, theoretical content will be offered through master classes (not compulsory). The rest of the learning activities will be developed on these theoretical contents.
• For each of the topics a debate can be opened in the forum (Virtual space) where issues will be resolved, by the teacher and the students themselves, related to the topic.
• According thematic contents and in order to apply the theoretical knowledge will realize the seminars, is an attended classes form (COMPULSORY). Prior to the seminar date, students will have to solve a questionnaire individually, through a virtual activity with a start and delivery date.
• If there is no changes, the laboratory practices will be done in person and are compulsory for all enrolled students. Previously, a dossier with the content of the practice and a questionnaire to be solved during the practice will be delivered.
• Prior to each assessment, tutorials will be carried out electronically in order to clarify those aspects of the subject about which the student has doubts.
• The assessment of the subject will have a continuous and non-recoverable part (50% of the subject) and another of recoverable theoretical contents (50% of the subject). Students who fail, next year will have to do all the scheduled activities

Evaluation

The final mark will be the sum of the different aspects evaluated:

1) The knowledge acquired in the theory classes and in the seminars will be assessed jointly in **two multiple-choice partial exams**. In order to average between the two partials, both must have been **passed with a grade equal to or greater than 5**, otherwise the subject will be considered failed. The average mark of these two exams represents **80% of the final grade** (each partial exam has the same weight when averaging). In case of failing any part, it can be recovered separately in the recovery exam.

2) The knowledge acquired in the **laboratory** sessions will be evaluated in a multiple choice exam to be carried out at the same time as the second partial exam. The grade for this exam will account for **20% of the final grade**, therefore this exam is **not recoverable**. No minimum mark for this exam is required in order to compute it in the final grade