



Universitat de Lleida

GUÍA DOCENTE **ESTRUCTURA Y FUNCIÓN CELULAR**

Coordinación: ENCINAS MARTIN, MARIO

Año académico 2022-23

Información general de la asignatura

Denominación	ESTRUCTURA Y FUNCIÓN CELULAR			
Código	100501			
Semestre de impartición	PRIMER CUATRIMESTRE			
Carácter	Grado/Máster	Curso	Carácter	Modalidad
	Grado en Medicina	1	TRONCAL/BÁSICA	Presencial
Número de créditos de la asignatura (ECTS)	12			
Tipo de actividad, créditos y grupos	Tipo de actividad	PRALAB	PRAULA	TEORIA
	Número de créditos	2	3.6	6.4
	Número de grupos	8	6	1
Coordinación	ENCINAS MARTIN, MARIO			
Departamento/s	MEDICINA EXPERIMENTAL			
Distribución carga docente entre la clase presencial y el trabajo autónomo del estudiante	Attended classes 120h Personal work 180h			
Información importante sobre tratamiento de datos	Consulte este enlace para obtener más información.			
Idioma/es de impartición	Català			
Distribución de créditos	Theoretical class 6 ECTS Seminars 4 ECTS Laboratory Practices 2 ECTS Tutorial activities 6 h			

Profesor/a (es/as)	Dirección electrónica\nprofesor/a (es/as)	Créditos impartidos por el profesorado	Horario de tutoría/lugar
BOADA PALLAS, JORDI	jordi.boada@udl.cat	17,6	
ENCINAS MARTIN, MARIO	mario.encinas@udl.cat	13,3	
YERAMIAN HAKIM, ANDREE	andree.yeramian@udl.cat	13,1	

Información complementaria de la asignatura

Cell Structure and Function (EFC), is a matter of first year Bachelor of Medicine taught during the first semester of the academic year. With the proposed work plan aims to provide students, who begin their medical studies, basic and necessary knowledge should allow them to understand the cellular processes related to functioning of the human body and the cellular interpret diseases. In addition, this knowledge should be able to use to solve health problems, using language related to basic scientific Cell Biology and Physiology General.

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 and General Physiology, 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. Moreover, instrumental competences allow student to get use the basic techniques for cell study will to collaborate in the acquisition of skills related to their ability to communicate, teamwork and in the use of ICT (Information and Communication Technologies) for obtaining and handling information,

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

Due one of the skills that medical students must acquire is a self and lifelong learning using new technologies, part of the subject will be taught virtually through the UdL Virtual Campus.

Objetivos académicos de la asignatura

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*

Competencias

CG7. Understand and recognize normal structure and function of human body, at molecular, cellular, tissue, organic and system levels in the different stages of life.

1 Know the cell structure and function

6 Cellular communication

7 Excitable membranes

8 Cell cycle

9 Cell differentiation and proliferation

25 Homeostasis

26 Adaptation to the environment

27 Use basic laboratory material and techniques

Contenidos fundamentales de la asignatura

Topic 1 Introduction to the human body.

Levels of organization. Form and function. Aqueous compartments. Intracellular medium. Extracellular medium (J. Boada).

Topic 2 Bioenergetic principles applicable to biological systems.

ATP energy-carrying molecule, electrochemical gradients. Oxidation reduction processes (J. Boada)

Topic 3. 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. (J. Ribera)

Topic 4. 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 (J. Ribera)

Topic 5. 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.(J.Ribera)

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 (J. Ribera)

Topic 7 Movement of water across membranes.

Mechanisms and transport models that regulate water exchanges between cellular compartments surrounded by membranes. Membrane permeability. Diffusion and movement of water: osmosis. Aquaporins (J. Boada, J. Ribera)

Topic 8 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. (J. Ribera)

Topic 9 Molecular transport through biological membrane

Transport at the molecular level: carriers, , channels and pumps. Coupling of molecular transport systems. Blood-brain barrier. (J. Boada)

Topic 10 Structures and non-membranous elements of the cytoplasm. Hyaloplasm

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

Topic 11 The ribosome.

Introduction to biological protein synthesis. The ribosome, structure and molecular organization. Free ribosomes and membrane-bound cytosolic ribosomes. Mitoribosomes. Ribosome as antibiotic target. Polyribosomes. Biogenesis of ribosomes. (J. Ribera)

Topic 12 Electrical properties of membranes.

Bioelectricity. Ionic bases of membrane potential. Excitable membranes. Electronic potential. Action potential. (J. Boada)

Topic 13 The neuron as a model of excitable cells.

Morphofunctional aspects of neurons. Polarity of neurons. Neural networks. Myelin sheath. Saltatory conduction. Neurotransmitter and receptor concepts. (J. Boada)

Topic 14 Homeostasis and adaptation to the environment.

Internal medium and environment. Conformism versus adaptation. Concept of homeostasis. Negative feedback. Positive feedback. Homeostasis and disease.

Topic 15 Physiological bases of cellular communication.

Stages of cellular communication. Extracellular signalling. Paracrine communication. Endocrine communication. Autocrine communication. Synaptic communication. (J. Boada)

Topic 16 Cell surface receptors and signalling.

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. (M. Encinas)

Topic 17 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 (M..Encinas)

Topic 18 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 (M. Encinas)

Topic 19 Muscle contraction.

Molecular and cellular bases of muscle contraction. Neuromuscular synapses. Skeletal muscle. Cardiac muscle. Smooth muscle. (J. Boada)

Topic 20 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. (J. Ribera)

Topic 21 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 (J. Ribera)

Topic 22 Cellular bases of hypoxia and oxidative stress.

Oxygen cascade. Cellular response to hypoxia: HIF. Anoxia. Hyperoxia. Reactive oxygen and nitrogen species. Oxidative stress. (J. Boada)

Topic 23 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 (M. Encinas)

Topic 24. Cell secretion.

Secretory cells. Glands. Exocrine secretions. Endocrine secretions. Endocrine axes and glands (J. Boada).

Topic 25 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. (J. Ribera)

Topic 26. Cell reproduction. 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 (M. Encinas)

Topic 27 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 28. Methods of study and research in cell biology.

Aspect of training to be developed as a practical activity in the laboratory. (J. Ribera, J. Boada and M. Encinas)

Ejes metodológicos de la asignatura

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.

Plan de desarrollo de la asignatura

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

Sistema de evaluación

La nota final será la suma de los distintos aspectos evaluados:

- 1) Los conocimientos adquiridos en las clases de teoría y en los seminarios se evaluarán conjuntamente en **dos exámenes parciales** de tipo test. Para poder hacer promedio entre los dos parciales, ambos se tendrán que **haber superado con una nota igual o superior a 5**, si no es el caso la asignatura se considerará suspendida. La nota promedio de estos dos exámenes supone el **85% de la nota final** (cada examen parcial tiene el mismo peso a la hora de promediar). En caso de suspender algún parcial éste se puede recuperar por separado en el examen de recuperación.
- 2) Los conocimientos adquiridos en las sesiones de **prácticas** de laboratorio se evaluarán en un examen tipo test a realizar en el mismo momento que el segundo parcial. La nota de este examen supondrá el **15% de la nota final, por tanto este examen no es recuperable**. No existe nota mínima para este examen a la hora de computar su resultado en la nota final.

Bibliografía y recursos de información

Cell Biology Books

- J. de Juan Herrero, E. Fernández, FJ Iborra, J. Ribera (2021) [*Biología Celular. Conceptos esenciales*](#) (2021) Medica Panamericana
- H. Lodish; A. Berk; CA. Kaiser; M. Krieger; A. Bretscher; H. Ploegh; KC. Martin; M. Yaffe; A. Amon (2021). [*Molecular Cell Biology*](#) (9th). Macmillan Learning Editor
- B. Alberts, A. Johnson, J. Lewis, P. Walter, M. Raff, K. Roberts (2017) -[*Molecular Biology of the Cell*](#). (6th). Ed Taylor & Francis Group
- G. Karp, J. Iwasa, W. Marshall. (2019) [*Karp's Cell and Molecular Biology*](#) (9th)Ed. Wiley

- G: Cooper (2018). [*The Cell: A Molecular Approach*](#) (8th). Ed Sinauer
- B. Alberts, K. Hopkin, A D Johnson, D. Morgan, M. Raff, K. P. Walter (2019) [*Essential Cell Biology*](#) (5th) WW Norton & co
- M L Casem (2016) [*Case Studies in Cell Biology*](#) (1st) Elsevier
- T. Pollard, W. Earnshaw, J. Lippincott-Schwartz, G. Johnson (2016) [*Cell Biology*](#) (3rd) Ed. Elsevier
- Pavelka M, Roth J (2005), [*Functional Ultrastructure*](#). An Atlas of Tissue Biology and Pathology. Ed Springer.
- Berkaloff A, Bourget J, Favard P, Lacroix JC (1981-83), [*Biologie et physiologie cellulaires*](#), (4 volumes). Éd. Hermann

Cell Biology Review Journals

- [Nature reviews molecular cell biology](#)
- [Trends in Cell Biology](#)
- [Journal of Cell Science](#)
- [The Annual Review of Cell and Developmental Biology](#)
- [Current Opinion in Cell Biology](#)

Microscopy Atlas

- [Looking at education through the microscope](#). SE. Prameela, PM. McGuiggan, A. Brusini, TW. Glenn. TP. Weih (2020). Nature Reviews Materials volume 5: 865–867.
- [Advanced Microscopy for the Teaching Laboratory](#). Dr. Jastrow's Elektron Microscopic Atlas.
- Microscopic Anatomy. RC. Wagner. FE. Hossler [Cell Ultrastructure](#) and [Cell and Tissue ultraestructure](#)
- Microfotografies microscopi òptic i electrònic, [La cèl·lula](#)