Universitat de Lleida

GUÍA DOCENTE

BIOLOGÍA CELULAR

Coordinación: ENCINAS MARTIN, MARIO

Año académico 2022-23

BIOLOGÍA CELULAR 2022-23

Información general de la asignatura

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<tr><td>Código</td><td>101503</td></tr>
<tr><td>Semestre de impartición</td><td>PRIMER CUATRIMESTRE</td></tr>
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<tr><td>Grado en Ciencias Biomédicas</td><td>1</td><td>TRONCAL/BÁSICA</td><td>Presencial</td></tr>
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<tr><td>Coordinación</td><td>ENCINAS MARTIN, MARIO</td></tr>
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<tr><td>Distribución carga docente entre la clase presencial y el trabajo autónomo del estudiante</td><td>Attended classes75h
Personal work 112,5h</td></tr>
<tr><td>Información importante sobre tratamiento de datos</td><td>Consulte este enlace para obtener más información.</td></tr>
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<tr><td>Distribución de créditos</td><td>Clases teóricas 41h
Seminarios 14h
Prácticas de Laboratorio 20 h</td></tr>
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BIOLOGÍA CELULAR 2022-23

Profesor/a (es/as)	Dirección electrónica\nprofesor/a (es/as)	Créditos impartidos por el profesorado	Horario de tutoría/lugar
ENCINAS MARTIN, MARIO	mario.encinas@udl.cat	5,6	
LLOVERA TOMAS, MARTA	marta.llovera@udl.cat	2,4	
YERAMIAN HAKIM, ANDREE	andree.yeramian@udl.cat	4,9	

Información complementaria de la asignatura

La Biología Celular es una materia fundamental en la formación de graduados en Biomedicina (Ciencias Biomédicas) por las implicaciones que tiene la Célula en el conocimiento del funcionamiento del cuerpo humano y las bases celulares de las enfermedades. En esta materia se quiere proporcionar a los alumnos que inicien los estudios del grado de Biomedicina (Ciencias Biomédicas), los conocimientos básicos y necesarios que les permitan entender los procesos celulares responsables del funcionamiento del cuerpo humano y las bases celulares para poder interpretar las causas y el origen de las enfermedades. Uno de los objetivos es que los estudiantes aprendan a usar estos conocimientos para diseñar modelos experimentales e interpretar las patologías humanas más prevalentes en nuestra sociedad como son el Cáncer, la Neurodegeneración, el Envejecimiento y las Enfermedades Metabólicas y Cardiovasculares, aplicando los conocimientos y lenguaje científico alcanzado con la Biología Celular. Además de facilitar la adquisición de competencias básicas transversales, se pretende que los estudiantes adquieran competencias terminológicas y conceptos básicos de Biología Celular tanto a nivel estructural como funcional. Esta materia es fundamental para profundizar en la Fisiopatología Humana, Patología Celular, Fisiología y los bloques de Patología de los cursos superiores. A nivel instrumental, además de familiarizar a los alumnos con las técnicas y aparatos empleados en el estudio de las células a nivel morfológicos, se colaborará en la adquisición de competencias relacionadas con su capacidad de comunicación, la realización del trabajo en equipo y en la utilización de las TIC (Tecnologías de la Información y Comunicación) para la obtención y manejo de la información,. Para poder facilitar un correcto seguimiento de esta materia, es aconsejable que los alumnos procedentes de Bachillerato hayan cursado, además de la Biología, la materia optativa Biología Humana.

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

Students have demonstrated that they have and understand the knowledge of an area of study that is based on general secondary education, and is at a level that, while supported by advanced textbooks, includes plus some aspects that involve knowledge from the avant-garde in the field of Cell Biology

Students have to know and to apply their knowledge to their profession o their job in a professionally way and they have to possess competencies that they demonstrate through the elaboration and the defence by arguments and the resolution of problems within the its area of study

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

Use and apply the microscopic methods used in biomedical research

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

Handle material and apply basic laboratory techniques

Contenidos fundamentales de la asignatura

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).

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

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

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 **80% 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 **20% 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* (3trd) 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