Universitat de Lleida

DEGREE CURRICULUM

CELL COMMUNICATION AND FUNCTION

Coordination: ESPINET MESTRE, MARIA CARMEN

Academic year 2023-24

CELL COMMUNICATION AND FUNCTION 2023-24

Subject's general information

Subject name	CELL COMMUNICATION AND FUNCTION
Code	14707
Semester	1st Q(SEMESTER) CONTINUED EVALUATION
Typology	

Degree	Course	Character	Modality
Master's Degree in Biomedical Research	1	OPTIONAL	Attendance-based

Course number of credits (ECTS)	4
Type of activity, credits, and groups	

Activity type	PRAULA	TEORIA
Number of credits	1.4	2.6
Number of groups	1	1

Coordination	ESPINET MESTRE, MARIA CARMEN
Department	EXPERIMENTAL MEDICINE
Important information on data processing	Consult this link for more information.
Language	English

CELL COMMUNICATION AND FUNCTION 2023-24

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Subject's extra information

The course is mainly focused on neuroscience

Learning objectives

1. To know the processes involved in cell signalling that regulate cell proliferation and differentiation.
2. To know the structure and function of ion channels involved in membrane excitability and the techniques used for study.
3. To advance knowledge of the process of synaptic transmission.
4. To know the intracellular pathways related to cell survival or death processes.
5. To know the process of programmed cell death during development, the apoptotic death, the excitotoxic death and the cellular and molecular mechanisms that control these processes.
6. To know the signaling mechanisms related to axon guidance.

7. To understand the mechanisms of cell communication mediated by gases.

Competences

CB1 Possess and understand knowledge that provides a basis or opportunity to be original in the development and / or application of ideas, often in a research context (*)

CB2 Know how to apply the knowledge acquired and have the ability to solve problems in new or unfamiliar environments within broader (or multidisciplinary) contexts related to their area of study (*)

CB3 Being able to integrate knowledge and face the complexity of formulating judgments based on information that, being incomplete or limited, includes reflections on the social and ethical responsibilities linked to the application of their knowledge and judgments (*)

CB4 Know how to communicate their conclusions –and the knowledge and ultimate reasons that support them– to specialized and non-specialized audiences in a clear and unambiguous way (*)

CB5 Possess the learning skills that allow them to continue studying in a way that will have to be largely self-directed or autonomous (*)

CG1 Know how to choose and apply the different methodologies of molecular, biochemical, cellular, genetic and phenotypic analysis for the diagnosis and study of diseases.

CG2 Know how to plan and execute a research project following the scientific method and appropriate technology with a high degree of initiative and commitment.

CG3 Ability of team-working, leadership and decision making.

CG4 Capacity for critical and creative thinking with their work and that of other researchers

CG5 Ability to prepare, process and interpret the results obtained rigorously and applying the appropriate technologies

CG6 Know how to guide research to lines of medical and translational interest (diagnosis and therapy)

CG7 Be able to present scientific reports and scientific articles that can be considered for publication in international journals

CE1 Recognize and value the importance of studies carried out in various unicellular and multicellular organisms as experimental models that are essential in the advancement of Medicine and Biomedical Sciences

CE2 Assess the importance of the protection of intellectual property and the transfer of knowledge to the industry and have the tools to carry it out.

CE3 Identify and assess the implications of the phenomenon of cell death in the genesis of multiple diseases and the rational bases for the derived therapeuthics

CE4 Recognize high throughput techniques and be able to use bioinformatics tools for data analysis.

CE5 Know how to describe national and European legislation on animal experimentation and be able to develop an animal experimentation procedure that can be favorably evaluated by an Ethical Committee for Animal Experimentation

CE6 Be able to design, monitor and evaluate clinical trial protocols.

CE7 Know how to identify the important molecules and processes in the functioning of cells and recognize the integration mechanisms of external signals that regulate complex functions such as differentiation, proliferation and survival

CE8 Be able to design and carry out experiments with animals according to the criteria of reducing the number of animals, minimizing suffering and applying alternative techniques

CE9 That the students know how to identify the effects of oxidative stress, the cellular mechanisms of response to stress and that they know how to apply the methods of detection and quantification of free radicals and biomarkers of molecular damage

CT1 Have a correct oral and written expression

CT2 Master a foreign language

CT3 Mastering ICT

CT4 Respect the fundamental rights of equality between men and women, the promotion of Human Rights and the values of a culture of peace and democratic values

CT5 Apply the gender perspective in the tasks of the professional field

Subject contents

1. Overview (Carme Espinet, 2 hours) Introduction to cell signaling. General principles of cell communication. 2. PDK1, the major transducer of PI 3-kinase actions (Jose Ramón Bayascas, 2 hours) PI3-K pathway in the context of insulin signaling. PDK1 action as a master kinase phosphorylating and activating differentially up to 23 different substrates. Study of PDk1 pathway by knock-in mutation and its role regulating metabolic responses to insulin. 3. Autophagy in the pathology of the Central Nervous System (Anna Garcerà, 2 hours) Autophagy pathways in neurons. Autophagy involvement in pathogenesis of neurodevelopmental and neurodegenerative disorders. Autophagy as a therapeutic target. 4. The neurodegenerative disease as a prion-like proteinopathy. (Sara Hernandez, 2 hours). Neurodegenerative diseases and proteinopathies. Prion and prion-like phenomena. Spreading mechanisms of misfolded proteins. Prion-like spreading in ALS. 5. Intracellular pathways related to neuronal cell survival or death: role in neurodegenerative diseases (Rosa Soler, 2 hours) Neurotrophic factors and their specific receptors: activation. Intracellular pathways: from the external signal to their effect in the cell. Suppressors or activators of intracellular proteins in neurodegenerative diseases. 6. Pro-neurotrophins and neurodegenerative diseases (Carme Espinet, 2 hours). Pro-NGF and pro-BDNF as ligands of p75NTR. p75NTR signalling pathways, intracellular interacting molecules and interaction with co-receptor partners. p75NTR processing and internalization. Pro-NGF/p75NTR modifications in Alzheimer's disease. pro-BDNF/p75NTR involvement in familiar depression. 7. Programmed cell death in spinal cord motoneurons during development (Jordi Calderó, 2 hours). The process of naturally (programmed) cell death of neurons, particularly of motoneurons. Apoptotic death. Cellular and molecular mechanisms that control these processes and the role played by specific neurotrophic factors as modulator agents. 8. Excitotoxicity and selective motoneuron vulnerability (Olga Tarabal, 2 hours). Glutamate receptors expression in neurons. Excitotoxic molecular mechanisms. Excitotoxic necrosis: the organotypic culture of chick embryonic spinal cord as a model to study excitotoxic necrosis. Chronic excitotoxicity and degeneration. Acute and chronic excitotoxicity in the model of chick embryo in vivo. 9. Signaling mechanisms of axon guidance receptors (Joaquim Egea, 4 hours) Description of the signaling mechanisms of Eph receptors and the mouse genetic approaches used to address their relevance in vivo. SEMINAR PROGRAM •. Solubilization of membrane protein complexes. Types of detergents. Effect of lipids on protein solubilization. Protocols for BN-PAGE. Applications of BN-PAGE. • Fluorescence Resonance Energy Transfer in living cells (FRET) (Marta Llovera, 2 hours). The principle of FRET. Fluorochrom pairs useful on FRET analysis. Applications. Methods for FRET detection. FRET-based biosensors. Real-time molecular interactions within living cells. • Image acquisition and processing on FRET experiments (Marta Llovera, 2 hours). Confocal microscope parameters for FRET image acquisition. MBF ImageJ software: image processing and quantification. Pseudocolouring and image composition. PRACTICAL PROGRAM • Methods to evaluate the involvement of a particular intracellular pathway in neuronal survival: experimental design (Rosa Soler and Ana Galcerá, 4 hours). To define the pathway that we want to analyze; and to develop and experimental design to study which effect causes the activation or the inhibition of this pathway on cultured neurons. • Calcium signalling (Olga Tarabal, 4 hours). Intracellular calcium imaging after loading neurons with Fura-2 AM. Calcium transients after application of agonists and antagonists of glutamate receptors. Calcium release from intracellular stores. Calcium induced calcium release (CICR) mechanism.

Methodology

Development and homeostasis of metazoan organisms is absolutely dependent on communication between their

building blocks, the cells. Such communication is usually achieved by the use of small, extracellular signaling molecules which act locally or globally to coordinate growth, differentiation, survival or metabolism of cells. Signaling molecules exert their actions on target cells through binding to specific receptors usually but not always located at the cell surface. Receptor binding causes a plethora of molecular responses, known as signal transduction pathways, meant to produce a characteristic biological response. In this course we aim to provide a general view of the vast field of signal transduction. Rather than systematically presenting current knowledge on the field, we will provide a first-hand view of specific topics, which will be presented by specialists who are actively developing their research on that particular aspect of the field. A practical block introducing state-of-the-art laboratory techniques will complement the theoretical sessions.

Evaluation

Presentation and discussion of scientific articles. (100%)

Bibliography

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INTERNET RESOURCES

The Wnt webpage: http://www.stanford.edu/~rnusse/wntwindow.html

http://www.ionchannels.org/

http://www.nature.com/nrm/focus/polarity/index.html

Blue Native Electrophoresis Protocol. MitoSciences

http://www.mitosciences.com

Dr. Louis Ignarro Explains Nitric Oxide:

http://www.youtube.com/watch?v=DcIWX8C91s4 i http://www.youtube.com/watch?v=NBPjZJSHr4A

MBF ImageJ webpage:

http://www.macbiophotonics.ca/imagej/

Olympus Confocal Microscopy Tutorials

http://www.olympusfluoview.com/java/index.html

Olympus FRET webpage

http://www.olympusfluoview.com/applications/fretintro.html

Nikon FRET webpage

http://www.microscopyu.com/tutorials/java/fluorescence/fpfret/

Interactive tutorial explores various combinations of fluorescent proteins as potential FRET partners and provides information about critical resonance energy transfer parameters, as well as suggestions for microscope optical filter and light source configuration.