UNIVERSIDADE DA CORUÑA

Teaching Guide				
Identifying Data				2022/23
Subject (*)	Cell Signaling		Code	610441004
Study programme	Máster Universitario en Bioloxía Molecular, Celular e Xenética			
Descriptors				
Cycle	Period	Year	Type	Credits
Official Master's Degree	1st four-month period	First	Obligatory	3
Language	Spanish			
Teaching method	Face-to-face			
Prerequisites				
Department	Bioloxía			
Coordinador	Rodriguez Belmonte, Esther	E-mail	esther.belmonte@udc.es	
Lecturers	Bernal Pita da Veiga, María de los Ángeles Carrillo Barral, Néstor Diaz Varela, Jose Rodriguez Belmonte, Esther	E-mail	angeles.bernal@udc.es n.carrillo@udc.es jose.diaz.varela@udc.es esther.belmonte@udc.es	
Web	https://masterciencias.udc.es/biologia_molecular_celular_y_genetica/			
General description	Within the Master in Molecular Cellular and Genetic Biology, this subject deepens in the knowledge of the biochemical processes that allow the signalling between animal and plant cells, the clinical and physiopathological aspects due to failures in these processes, as well as the molecular tools that are used for their study and those possible industrial applications that derive from such research.			

Study programme competences / results	
Code	Study programme competences / results
A1	Skills of working in a sure way in the laboratories knowing operation handbooks and actions to avoid incidents of risk.
A2	Skills of using usual techniques and instruments in the cellular, biological and molecular research: that are able to use techniques and instruments as well as understanding potentials of their uses and applications.
A4	Skills to apply molecular techniques to the study of the plant cell physiology, its response to external triggers and their biotechnological applications.
A6	Skills of understanding the functioning of cells through the structural organization, biochemistry, gene expression and genetic variability.
A7	Skills of knowing and analyzing specific cellular systems as stem cells, nerve cells, cells of the immune system, or other cells related to several pathologies.
A13	Skills to become a professional in health, pharmacy, veterinary, animal production, biotechnology or food sectors.
B1	Analysis skills to understand biological problems in connection with the Molecular and Cellular Biology and Genetics.
B2	Skills of decision making for the problem solving: that are able to apply theoretical knowledges and practical acquired in the formulation of biological problems and the looking for solutions.
B3	Skills of management of the information: that are able to gather and to understand relevant information and results, obtaining conclusions and to prepare reasoned reports on scientific and biotechnological questions
C2	Ability to know and use appropriately the technical terminology of the field of knowledge of the master, in the native language and in English, as a language of international diffusion in this field

Learning outcomes			
Learning outcomes	Study programme competences / results		
Perform a comprehensive reading of scientific texts related to the module materials.		BR3	CC2
Skills of critical assessment of assumptions and interpretation of results		BR1 BR2	
Understanding of the structure and function of the cells from an interdisciplinary perspective on where the Cell Biology, Cytology, Genetics and Molecular Biology converge.	AR6 AR7		

Understanding of the biochemical and physiological processes that allow signaling between cells and structural elements, as well as causing aspects of diseases related to alterations in cellular signalling and the tools used to study	AR6		
Acquire knowledge on experimental techniques to the study of the molecular mechanisms of regulation of gene expression as well as the molecular machinery involved in these process and its systems of regulation	AR4		
Learn about the characteristics of proteins and complexes involved in the regulation of gene expression, their interaction with genetic material, and the enzymatic reactions that modulate its activity	AR6		
Acquire knowledge on experimental techniques used in the study of the molecular mechanisms involved in mammalian cell signaling	AR4 AR13	BR1 BR2	
Learn about some of the experimental techniques used to study signaling in plants	AR1 AR2 AR4 AR13	BR1 BR2	
Understanding of the processes involved in signaling during the different phases of the plant development and their response to the environment	AR6		

Contents	
Topic	**Sub-topic**
Biochemical mechanisms of cell signaling.	Description of the elements involved in cell signaling: signals, receptors, and signal transduction mechanisms.
Examples in animal cells.	Cell signaling in Cell cycle, Apoptosis, Cancer and Cellular Aging
Examples in plant cells.	Phytohormones: Perception and Signal Transduction. Light perception and signalling in plants. The control of developmental phase transitions in plants: vegetative, reproductive and senescence phases.
Laboratory practical classes	Practical laboratory work on cell signaling

Planning				
Methodologies / tests	**Competencies / Results**	**Teaching hours (in-person & virtual)**	**Student?s personal work hours**	**Total hours**
Introductory activities	B2	1	0	1
Guest lecture / keynote speech	A6 A7	13	0	13
Directed discussion	A6 A13 B1 B3 B2	0	7	7
Objective test	A4 A6 A7 B1 B2	2	24	26
Laboratory practice	A2 A1 A4 A13 B1 B2	7	13	20
Document analysis	B3 C2	0	5.5	5.5
Personalized attention		2.5	0	2.5
(*)The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.				

Methodologies	
Methodologies	**Description**
Introductory activities	Introduction to the subject: brief description of the contents, activities and schedule of the course.
Guest lecture / keynote speech	Lectures on the topics of the subject, debate and active discussion with the students on such content.Theoretical classes will be taught using presentations in Power Point or similar programs. All the material used to teach master classes will be available to students in the UDC Moodle virtual platform.
Directed discussion	Selection of topical articles related to the themes of the course. Students will have to make an oral presentation or a written report, explaining the methodology used, as well as the social and scientific impact of the research.
Objective test	The exam to evaluate the level of theoretical knowledge on the topics of the subject will consist of multiple choice questions, problems, and short answer questions about the theoretical content.
Laboratory practice	Carrying out, individually or in group, a small research work in the lab, related to cell signaling. Presentation of the results in a scientific paper format.

Document analysis	For the preparation of the directed discussion, students should make a prior search for scientific articles in the bibliographic databases recommended by teachers. Students will select the most appropriate scientific works and they will make an analysis of the methodology and the impact of the results obtained in the society.

Personalized attention	
Methodologies	**Description**
Objective test Laboratory practice Directed discussion Guest lecture / keynote speech Document analysis	Students may ask for tutoring classes (previous e-mail appointment) in order to answer any questions on: - the material taught in the course - preparation of the issues to be addressed in the different activities - bibliographic material and other resources that can be used to perform various activities - the presentation of practical work

Assessment			
Methodologies	**Competencies / Results**	**Description**	**Qualification**
Objective test	A4 A6 A7 B1 B2	Objective exam consisting of: -multiple choice test -short answer questions -problems	40
Laboratory practice	A2 A1 A4 A13 B1 B2	Carrying out, individually or in group, a small research work in the lab, related to cell signaling. Presentation of the results in a scientific paper format.	30
Directed discussion	A6 A13 B1 B3 B2	Selection of topical articles related to the themes of the course. Defense and discussion, with the other students and teachers, of the methodology used, and the social and scientific impact of such research.	30

Assessment comments
STUDENTS WITH DIFFICULTIES FOR ATENDANCE. Those students who, for various reasons that may show, may not be able to attend any assessable activities, must put in contact with the teachers of the subject during the first week of the course in order to coordinate alternative activities to achieve 100% of the possible points. The students with top marks in the first evaluation period (June) will have priority to achieve MATRÍCULA DE HONOR (qualification with Honors)

Sources of information	
Basic	- LODISH H, DARNELL J., BERK A., ZIPURSKY L., MATSUDAIRA P. y BALTIMORE D. (2002). Biología Celular y Molecular, 4ª ed. (y posteriores). Editorial Médica Panamericana. S.A. - ALBERTS B, JOHNSON J, LEWIS J, RAFF M, ROBERTS K, WALTER P (2002). Molecular Biology of the Cell 4ª ed.. Garland Publishers INTRODUCCIÓN A LA SEÑALIZACIÓN CELULAR LODISH H, DARNELL J., BERK A., ZIPURSKY L., MATSUDAIRA P. y BALTIMORE D. Biología Celular y Molecular, 4ª ed. Editorial Médica Panamericana. S.A. (2002) y ediciones posteriores. ALBERTS B, JOHNSON J, LEWIS J, RAFF M, ROBERTS K, WALTER P. Molecular Biology of the Cell 4ª ed. Garland Publishers (2002) y ediciones posteriores.

Complementary	- HELMREICH (2002). The Biochemistry of Cell Signalling. Oxford University Press Inc. New York. - KRAUSS (2001). Biochemistry of Signal Transduction and Regulation. 2nd ed.. Wiley-VCH. Weinhein. - STEIN & PARDEE (2004). Cell Cycle and Growth Control. 2nd ed.. John Wiley & Sons Inc. New Jersy. - GEWIRTZ, HOLT & GRANT (2007). Apoptosis, Senescence and Cancer. 2nd ed. . Humana Press. New Jersey. - WEINBERG (2007). The Biology of Cancer.. Garland Science, Taylor and Francis Group, LLC. New York. - BALUSKA, F. & MANCUSO, S. (2009). Signaling in Plants.. Springer Verlag. - DEL RIO, L.A. & PUPPO, A. (2009). Reactive Oxygen Species in Plant Signaling.. Springer Verlag. - JONES, R., OUGHAM, H., THOMAS, H. & WAALAND, S. (2013). The molecular life of plants.. Wiley-Blackwell - PFANNSCHMIDT, T. (2009). Plant signal transduction. Methods and protocols.. Springer Verlag. - BHATLA, S.C. & LAL, M.A. (2018). Plant physiology, development and metabolism. Springer - BUCHANAN, B.B., GRUISSEM, W: & JONES; R.L. (2015). Biochemistry and molecular biology of plants. Wiley Blackwell - Taiz, L., Zeiger, E., Moller, A.M. & Murphy, A. (2022). Plant Physiology and Development, 7th ed.. Oxford University Press. - YANG, Z. (2008). Intracellular Signaling in Plants.. Wiley-Blackwell. EJEMPLOS DE SEÑALIZACIÓN EN MAMÍFEROS HELMREICH (2002). The Biochemistry of Cell Signalling. Oxford University Press Inc. New York. KRAUSS (2001). Biochemistry of Signal Transduction and Regulation. 2nd ed. Wiley-VCH. Weinhein. STEIN & PARDEE (2004). Cell Cycle and Growth Control. 2nd ed. John Wiley & Sons Inc. New Jersy. GEWIRTZ, HOLT & GRANT (2007). Apoptosis, Senescence and Cancer. 2nd ed. Humana Press. New Jersey. WEINBERG (2007) The Biology of Cancer. Garland Science, Taylor and Francis Group, LLC. New York. EJEMPLOS DE SEÑALIZACIÓN EN PLANTAS BALUSKA, F. & MANCUSO, S. (2009). Signaling in Plants. Springer Verlag. BHATLA, S.C. & LAL, M.A. (2018). Plant physiology, development and metabolism. Springer.BUCHANAN, B.B., GRUISSEM, W. & JONES, R.L. (2015). Biochemistry and molecular biology of plants. Wiley BlackwellDEL RIO, L.A. & PUPPO, A. (2009).Reactive Oxygen Species in Plant Signaling. Springer Verlag. JONES, R., OUGHAM, H., THOMAS, H. & WAALAND, S. (2013). The molecular life of plants. Wiley-Blackwell.PFANNSCHMIDT, T. (2009). Plant signal transduction. Methods and protocols. Springer Verlag. TAIZ, L., ZEIGER, E., Moller, I,M. & Murphy, A. (2015). PLant physiology and development, 6th edition. Sinauer Associates. YANG, Z. 2008. Intracellular Signaling in Plants. Wiley-Blackwell. YOSHIOKA, K. & SHINOZAKI, K. (2009). Signal crosstalk in plant stress responses. Signal crosstalk in plant stress responses. Artículos científicos de revisión: de forma actualizada, se dispondrán artículos científicos sobre los temas tratados en la asignatura en la plataforma virtual Moodle de la asignatura

Recommendations
Subjects that it is recommended to have taken before
Stem Cells and Cell Therapy/610441010 Molecular Plant-Pathogen Interaction Mechanisms/610441019
Subjects that are recommended to be taken simultaneously
Advanced Cellular Biology/610441003 Regulation of gene expression/610441006
Subjects that continue the syllabus
Other comments