Teaching Guide					
Identifying Data					2022/23
Subject (*)	Evolution of the nervous system			Code	610490022
Study programme	Mestrado Universitario en Neurociencia (Plan 2011)				
Descriptors					
Cycle	Period	Year		Type	Credits
Official Master's Degree	2nd four-month period	First		Optional	3
Language	Spanish				
Teaching method	Face-to-face				
Prerequisites					
Department	Bioloxía				
Coordinador	Castro Castro, Antonio Manuel		E-mail	antonio.castro@udc.es	
Lecturers	Castro Castro, Antonio Manuel Folgueira Otero, Mónica Vaamonde García, Carlos Yañez Sanchez, Julian		E-mail	antonio.castro@udc.es m.folgueira@udc.es carlos.vaamonde.garcia@udc.es julian.yanez@udc.es	
Web	www.usc.gal/es/estudios/masteres/ciencias-salud/master-universitario-neurociencia				
General description	Optional subject focused on the adaptive changes experienced by the nervous system and sensory organs during evolution.				

Study programme competences / results	
Code	Study programme competences / results
A3	Explicar o proceso de cambio adaptativo do sistema nervioso dentro do marco evolutivo.
B4	Saiban ler e obter información relevante de publicacións científicas.
C1	Expresarse correctamente, tanto de forma oral coma escrita, nas linguas oficiais da comunidade autónoma.
C2	Dominar a expresión e a comprensión de forma oral e escrita dun idioma estranxeiro.
C3	Utilizar as ferramentas básicas das tecnoloxías da información e as comunicacións (TIC) necesarias para o exercicio da súa profesión e para a aprendizaxe ao longo da súa vida.

Learning outcomes			
Learning outcomes	Study programme competences / results		
To know the adaptive changes in the nervous system and organs of the senses during evolution.	AR3	BR4	CR1 CR3
To manage and analyze specialized bibliography/literature		BR4	CR1 CR2 CR3

Contents	
Topic	Sub-topic
Introduction.	1.Concept of evolution. Theories. 2.Levels of organization. Design patterns in animals. 3.Phylogenetic relationships: homologies and analogies.
Evolution of the nervous system.	4.Origin of neurons (first nervous systems). 5.Models of nervous systems. 6.Evolutionary changes of the basic structural units of the central nervous system in vertebrates. 7.Evolutionary changes of the functional circuits of the nervous system in vertebrates.

Evolution of sensory organs.	8.Photoreception: Evolution of the visual system. 9.Chemoreception: Evolution of taste and olfactory systems. 10.Mechanoreception: Evolution of the ear and lateral line
Practicals	Students will study, in images, the organization of the nervous system, in relation to their changes during evolution. Also, students will solve practical cases.

Planning				
Methodologies / tests	Competencies / Results	Teaching hours (in-person & virtual)	Student?s personal work hours	Total hours
Guest lecture / keynote speech	A3	19	28.5	47.5
Seminar	A3 B4 C1 C3	3	4.5	7.5
Laboratory practice	A3	5	6	11
Online discussion	B4 C1 C2 C3	2	3	5
Introductory activities	C3	1	0	1
Mixed objective/subjective test	A3 C1	2	0	2
Personalized attention		1	0	1
(*)The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.				

Methodologies	
Methodologies	Description
Guest lecture / keynote speech	Teacher will present the main contents of the subject.
Seminar	During these sessions, students will present the work they have carried out under the supervision of the professor. For preparing the seminars, students will use recent scientific reviews and other sources. Works will be sent in digital format.
Laboratory practice	Students will study, in images, the organization of the nervous system, in relation to their changes during evolution. Also, students will solve practical cases.
Online discussion	A session will be devoted to the discussion of a specific topic (scientific article) by the students, intervening the professor as moderator.
Introductory activities	A first session will be programmed, in which the different sections contained in the teaching guide will be presented (learning aims, contents, methodologies, assessment, sources of information...), and where the student may raise any doubt or question regarding the same. Teaching guide and a detailed schedule of the activities will be available to the student in the Virtual Campus platform.
Mixed objective/subjective test	Take a test (exam) will account for 50% of the final grade.

Personalized attention	
Methodologies	Description
Seminar	Students (in person or online) can do any questions regarding the work they must carry out in the seminars or relating to the rest of the methodologies used. In the case of students with recognition of part-time dedication and assistance exemption, they may make any questions related to the subject by attending individual tutorials, by email, Virtual Campus or Microsoft Teams.

Assessment			
Methodologies	Competencies / Results	Description	**Qualification**
Online discussion	B4 C1 C2 C3	Discussion of a specific topic (specialized scientific article) by the student.	10
Seminar	A3 B4 C1 C3	Students must carry out and present a work in relation with the contents of the program.	40

Mixed objective/subjective test	A3 C1	Take a exam (test questions and/or short-answer questions) about the contents of the program.	50

Assessment comments
General considerations: Students will have two official opportunities to pass the subject (see https://www.usc.gal/en/titulacions/masters_oficiais/neurosci/index.html). The grade of Not Presented will be applied in the event that the student does not appear for the corresponding tests in the official evaluation opportunities. Aspects and evaluation criteria: -Full-time students and students with recognition of part-time dedication and academic waiver of attendance exemption In the opportunity of the end of the semester (first opportunity), the different sections collected in the evaluation system will be taken into account for the computation of the final qualification: a) test/exam will represent 50%, b) work in seminars will represent 40%), and c) online discussion will account for 10% of the final grade. On the second opportunity, the test/exam and the work parts may be recovered, assuming 50% and 50% of the final grade, respectively. Note: The fraudulent performance of the tests or evaluation activities will entail the application of current regulations in this regard.

Sources of information

Basic	- Kaas, JH (2007). Evolution of nervous systems: a comprehensive reference. Elsevier Academic Press, Amsterdam - Allman, JM 2003, El cerebro en evolución, 1ª edn, Editorial Ariel, Barcelona.- Arendt, D 2003, ?Evolution of eyes and photoreceptor cell types?, IntJDevBiol, vol. 47, pp. 563-571.- Butler, AB & Hodos, W 2005, Comparative vertebrate neuroanatomy, 2nd edn, Wiley-Liss, New York. - Collin, SP, Davies, WL, Hart, NS & Hunt, DM2009, ?The evolution of early vertebrate photoreceptors?, Phil Trans R Soc B, vol. 364, pp. 2925-2940.- Coyne, JA 2010, Porqué la teoría de la evolución es verdadera, Editorial Crítica, Barcelona.- Eccles, JC 1992, La evolución del cerebro: creación de la conciencia, Editorial Labor, Barcelona. - Fay, RR & Popper, AN 1999, Comparative hearing: fish and amphibians, Springer-Verlag, New York. - Fritzsch, B & Beisel, KW 2001, ?Evolution and development of the vertebrate ear?, BrainResBull, vol. 55, pp.711-721. - Fritzsch, B, Beisel, KW, Pauley, S &Soukup, G 2007, ?Molecular evolution of the vertebrate mechanosensory cell andear?, Int J Dev Biol, vol. 51, pp.663-678. - Gehring, WJ 2005, ?New perspectives on eye development and the evolutionof eyes and photoreceptors?, J Hereditv,vol. 96, no. 3, pp. 171-184.- Gregory, RL 1997, Eye and Brain, 5th edn, Princeton University Press. - Hubel, DH2000, Ojo,cerebro y visión. Servicio Publicaciones Univ. Murcia. - Jarman, AP 2002, ?Studies of mechanosensation using the fly?, HumanMolecularGenetics, vol. 11, no. 10, pp. 1215-1218. - Jorgensen, JM 1989, Evolution of octavolateralis sensory cells. In: Coombs, S, Görner, P, Münz, H(eds), The mechanosensory lateral line: neurobiology and evolution,Springer-Verlag, New York.- Kaas, JH 2007, Evolution of nervous systems: a comprehensive reference, Elsevier Academic Press, Amsterdam. - Kaas, JH 2009, Evolutionary neuroscience, Elsevier, Amsterdam. - Kuhlenbeck, H 1967-1970, The central nervous system of vertebrates ageneral survey of its compararive anatomy with an introduction to the pertinentfundamental biologic and logical concepts, S. Karger, Basil. - Lad, MF1979, ?Ojos animales donde la imagen se forma mediante espejos?, InvestigaciónyCiencia, no. 29. - Laget, M 1973, Éléments de neuro-anatomie fonctionnelle, Masson, Paris. - Lamb, TD, 2009, ?Evolution of vertebrateretinal photoreception?, Phil Trans R SocB, vol. 346, pp. 2911-2924. - Land, MF & Ferdnald, RD 1992, ?The evolution of eyes?, Annual ReviewofNeuroscience, vol. 15, pp. 1-29. - Manley, GA, Popper, AN & Fay, RR (eds) 2004, Evolution of the Vertebrate Auditory System, Springer-Verlag.- Melver, SB 1985, Mechanorecepcion, In Gilbert, LL & Kerkut, DA (eds) Comprehensive Insect Physiology, Biochemistry and Pharmacology, Pergamont Press, vol. 6, pp. 71-132. - Münz, H (eds) 1989, The mechanosensory lateral line, Springer-Verlag, New York.- Nieuwenhuys, R, ten Donkelaar, HJ & Nicholson, C 1998, The central nervous system of vertebrates, Springer, Berlin. - Nilsson S & Holmgreen S 1993, Comparative physiology and evolution of the autonomic nervous system, Hardwood Academic Publishers, Chur, Switzerland.- Paxinos, G 1995, The rat nervous system, Academic Press, New York.- Roth, G 2013, The long evolution of brains and minds, Springer,Dordrecht.- Ruiz Rey, F 2014, Teoría de la revolucióndarwiniana: una hipótesis en receso, OIACDI, Charleston.- Shichida, Y & Matsuyama, T 2009, ?Evolution of opsins andphototransduction?, Phil Trans R Soc B,vol. 364, pp. 2881-2895. - Soler, M (ed) 2003, Evolución. La base de laBiología, Proyecto Sur de Ediciones, Granada.- Striedter, GF 2005, Principles of brain evolution, Sinauer Associates, Sunderland (Massachusetts).- Swanson, LW 2012, Brain architecture. Understanding the basic plan,2nd edn, Oxford University Press, New York.- Williamson, R & Chrachri, A 2007, ?A model biological network: thecephalopod vestibular system?, Phil Trans R Soc B, vol. 362, pp. 473-481.Recursos web: https://books.google.es/ https://pubmed.ncbi.nlm.nih.gov/ https://www.cell.com/current-biology/home https://www.europeana.eu/eshttps://archive.org/ Recursos electrónicos udc: https://kmelot.biblioteca.udc.es/search~S1*gag?/revoluci{226}on+del+sistema+nervioso/revolucion+del+sistema+nervioso/-3%2C0%2C0%2CB/frameset&FF=revolucion+do+sistema+nervioso+mestrado+universitario+en+neurociencia+plan+2011+recursos+electronicos&1%2C1%2C/indexsort=-
Complementary	

Recommendations
Subjects that it is recommended to have taken before
Neuroanatomy/610490003

Subjects that are recommended to be taken simultaneously
Subjects that continue the syllabus
Other comments

(*)The teaching guide is the document in which the URV publishes the information about all its courses. It is a public document and cannot be modified. Only in exceptional cases can it be revised by the competent agent or duly revised so that it is in line with current legislation.