Teaching Guide				
Identifying Data				2013/14
Subject (*)	Paleobioloxía		Code	610G02043
Study programme	Grao en Bioloxía			
Descriptors				
Cycle	Period	Year	Type	Credits
Graduate	1st four-month period	Fourth	Optativa	6
Language	SpanishEnglish			
Prerequisites				
Department	Ciencias da Navegación e da Terra			
Coordinador	Bao Casal, Roberto	E-mail	roberto.bao@udc.es	
Lecturers	Bao Casal, Roberto Grandal D`Anglade, Aurora	E-mail	roberto.bao@udc.es aurora.grandal@udc.es	
Web	campusvirtual.udc.es/moodle/			
General description	Esta asignatura estuda os procesos biolóxicos que operan a escala xeolóxica de tempo. Despois de unha introducción as características principais do rexistro fósil e a súa representatividade, se estudan aspectos relativos a análise da forma orgánica, o papel do rexistro fósil no desenvolvemento da Teoría Evolutiva moderna e a análise de procesos paleoecolóxicos e paleobioxeográficos dende una perspectiva evolutiva. No último bloque da materia se pretende obter unha visión da evolución da diversidade da vida ó longo do tempo xeolóxico no contexto dun planeta cambiante, e relacionar os coñecementos xa adquiridos, cara a interpretación da Terra como Sistema. O enfoque da asignatura é eminentemente conceptual, deixando os aspectos mais puramente descriptivos (Paleontoloxía Sistemática) para as prácticas de laboratorio.			

Study programme competences	
Code	Study programme competences
A1	Recoñecer distintos niveis de organización nos sistemas vivos.
A2	Identificar organismos.
A3	Recoñecer, obter, analizar e interpretar evidencias paleontológicas.
A6	Catalogar, avaliar e xestionar recursos naturais.
A22	Describir, analizar, avaliar e planificar o medio físico.
A27	Dirixir, redactar e executar proxectos en Bioloxía.
A29	Impartir coñecementos de Bioloxía.
B1	Aprender a aprender.
B2	Resolver problemas de forma efectiva.
B3	Aplicar un pensamento crítico, lóxico e creativo.
B8	Sintetizar a información.
B9	Formarse unha opinión propia.
B10	Exercer a crítica científica.
B11	Debater en público.
C1	Expresarse correctamente, tanto de forma oral coma escrita, nas linguas oficiais da comunidade autónoma.
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.
C4	Desenvolverse para o exercicio dunha cidadanía aberta, culta, crítica, comprometida, democrática e solidaria, capaz de analizar a realidade, diagnosticar problemas, formular e implantar solucións baseadas no coñecemento e orientadas ao ben común.
C6	Valorar criticamente o coñecemento, a tecnoloxía e a información dispoñible para resolver os problemas cos que deben enfrontarse.
C7	Asumir como profesional e cidadán a importancia da aprendizaxe ao longo da vida.
C8	Valorar a importancia que ten a investigación, a innovación e o desenvolvemento tecnolóxico no avance socioeconómico e cultural da sociedade.

Learning outcomes			
Subject competencies (Learning outcomes)	Study programme competences		
To understand the concept of deep (geologic) time	A3 A22	B9 B10	C6
To understand the processes of fossilization and the biases of the fossil record as indicator of ancient biospheres	A2 A27	B1 B3	C1 C6 C7 C8
To understand how biological processes occuring at geological time scales, such as evolution or mass extinctions, cannot always be understood as simple extrapolations of processes taking place at present times	A2 A27	B1 B3	C1 C6 C7 C8
To expand our understanding of Evolutionary Theory from a multidisciplinary perspective	A2 A27	B1 B3	C1 C6 C7 C8
To know the fossil groups that make up the fossil record and their practical uses	A1 A2 A3 A27	B1 B3	C1 C6 C7 C8
To identify the main bioevents in the history of the Earth, their causes and aftermath	A1 A2 A3 A22 A27	B1 B2 B8 B9 B10 B11	C3 C6
To synthesize knowledge from a long array of subjects such as Geology, Ecology, Microbiology, Biochemistry, Botany or Zoology in the framework of an ever changing Earth	A2 A3 A6 A22 A29	B3 B8 B9 B10	C4 C6 C7 C8

Contents	
Topic	Sub-topic
SECTION-1.	HISTORY AND CONCEPT OF PALEOBIOLOGY
Lesson 1. An introduction to Paleobiology	1.1 Introduction 1.2 Theoretical and methodological aspects 1.3 Divisions of Paleobiology
SECTION-2.	TAPHONOMY
Lesson 2. The concept of fossil. Taphonomy	2.1 Introduction 2.2 The concept and types of fossils 2.3 Biostratinomy 2.4 Diagenesis of fossils 2.5 Ichnofossils 2.6 Time-averaging 2.7 Fossil-lagerstätten 2.8 Representativity of the fossil record
SECTION-3.	BIOSTRATIGRAPHY

Lesson 3. Biostratigraphy	3.1 Introduction 3.2 Index fossils 3.3 Biohorizons and Biozones 3.4 Signor-Lipps effect 3.5 Lazarus, Elvis and Zombie taxa
SECTION-4.	HISTORY OF LIFE
Lesson 4. Time and Geology	4.1 Dating methods 4.2 The geologic time scale
Lesson 5. The origin and early evolution of Earth and Life	5.1 Origins of the Solar System and Earth. 5.2 Origin and evolution of the Atmosphere. 5.3 Origin of the Hidrosphere. 5.4 Origin and evolution of the continents. 5.5 The first life forms.
Lesson 6. The diversification of Life	6.1 The Ediacaran Fauna and other life forms. 6.2 The Cambrian Explosion. 6.3 Evolution of life forms during the Paleozoic. 6.4 Terrestrialization.
Lesson 7. Mass extinction events	7.1 Mass extinctions. Causes and their aftermath. 7.2 The end-Permian extinction. 7.3 The end-Cretaceous extinction.
Lesson 8. Climate and Life	8.1 Climatic evolution of the planet Earth. 8.2 Global glaciations. Methods of study. 8.3 The Snowball Earth hypothesis. 8.4 The influence of climatic change on the Quaternary faunas and floras.
SECTION-5.	MORPHOLOGICAL ANALYSIS
Lesson 9. Size and Shape in Fossils	9.1 Introduction 9.2 The analysis of morphometrical variability 9.3 Types of growth 9.4 Population variability 9.5 Ecophenotypic variability 9.6 Sexual dimorphism 9.7 Taphonomical variability
Lesson 10. Ontogeny and Heterochrony	10.1 Introduction 10.2 Biogenetic and von Baer's Law 10.3 Heterochrony and its types 10.4 Heterochrony and allometry 10.5 Heterochronoclines 10.6 Dissociated heterochrony 10.7 Evolutionary consequences of heterochrony
Lesson 11. Morphodynamics and the Evolution of Form	11.1 Introduction 11.2 Constructional morphology. Phylogenetic factor. Functional factor. Fabricational factor. Other factors 11.3 Research methods in morphodynamics. Biomechanical analysis. Theoretical morphology
SECTION-6.	EVOLUTIONARY PALEONTOLOGY
Lesson 12. Classification and Phylogeny	12.1 Introduction 12.2 Methods of classification. Essentialism, evolutionary, phenetic and cladistic classification 12.3 Fossils and Phylogeny. Stratocladistics. Phylogenetic trees

Lesson 13. Speciation	13.1 Introduction 13.2 Species concepts 13.3 Modes of speciation 13.4 The problem of species concept in Paleontology
Lesson 14. Modes of evolution	14.1 Introduction 14.2 Darwinism and the Synthetic Theory of Evolution 14.3 Modes of evolution and the fossil record. Phyletic gradualism and punctuated equilibria 14.5 Evolutionary trends 14.6 Species selection 14.7 Coordinated stasis
Lesson 15. Biotic crises	15.1 Introduction 15.2 Concept and types of extinction 15.3 Recovery after a mass extinction 15.4 Effects of mass extinctions on evolution 15.5 Periodicity of mass extinctions
Lesson 16. Paleobiogeography	16.1 Introduction 16.2 Dispersal biogeography 16.3 Paleogeography and paleoclimatology 16.4 Vicariance biogeography 16.5 Biogeographic patterns and extinctions
Lesson 17. Evolutionary ecology	17.1 Introduction 17.2 Phanerozoic trends in global diversity. Explanatory hypotheses 17.3 Law of constant extinction. Red Queen Hypothesis and alternative explanatory hypotheses 17.4 Clade interactions

Planning			
Methodologies / tests	Ordinary class hours	Student?s personal work hours	Total hours
Document analysis	12	24	36
Workshop	12	24	36
Case study	8	16	24
Laboratory practice	6	6	12
Field trip	9	9	18
Objective test	2	10	12
Personalized attention	12	0	12
(*)The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.			

Methodologies	
Methodologies	Description
Document analysis	There will be reading assignments based on textbook chapters and scientific papers. Because some of the materials to be tested are not covered in the readings, the lecturers will expand on them during the class. Both readings and explanations by the lecturers during classtime make up the theory classes. All readings need to be done prior to the classtime they are listed
Workshop	Readings and contents delivered by the lecturers will be discussed during classtime (remember that all readings need to be done in advance). Quizzes covering readings and extra content will be delivered on a regular basis. Both quizzes and class participation will be used in the calculation of the grade. All slides used during classtime will be available through the Moodle platform

Case study	The lecturers will choose a hot debate topic in Paleontology and students will make a database review of several case studies illustrating this debate. Each student will pick up one of these case studies and provide a short written summary and critique of this reading. An oral presentation with discussion and comments will also take place in due time. Personal tutorials will be carried out on a regular basis before oral presentation. Attendance to the case study sessions is compulsory
Laboratory practice	Lab exercises will focus on the recognition of basic morphological features of fossils and identification of important taxa from the Iberian Peninsula. Students will be required to take their own notes and answer the lab quizzes. Attendance to the lab sessions is compulsory
Field trip	There will be an approximately 9 hours field trip (whole day including transportation) to the sorroundings of La Barosa and Salas de la Ribera (province of León) to explore outcrops with Silurian and Devonian fossils
Objective test	Grading is primarily based on the idea of continuous assessment and so, the final exam IS NOT REQUIRED for those students being successful during this continuous assessment. Students failing specific parts or the whole subject are required to make the final exam for the parts they failed

Personalized attention	
Methodologies	**Description**
Workshop Laboratory practice Case study	Attendance to tutorials is expected, especially for those aspects showing greater difficulty such as the case study sessions, quizzes solving, exams or field trip observations

Assessment		
Methodologies	**Description**	**Qualification**
Workshop	Continuous assessment will take place using in-class quizzes and participation during classes. All quizzes can involve multiple choice, matching, true-false questions, fill in the blank questions or short answer and essay questions. Quizzes make up 50% of the final grade, whereas participation in class will add up another 20%	65
Laboratory practice	Grading of lab sessions will be carried out with the lab quizzes and the exam on fossil identification	10
Objective test	As stated in Step 5, grading is primarily based on the idea of continuous assessment and so, the final exam IS NOT REQUIRED for those students being successful during this continuous assessment. For the rest of students a final exam will be carried out for the specific parts of the subject (i. e., theory 70%, case studies 20% or lab sessions 10%) that they failed	0
Case study	The students are expected to produce a short written summary and an oral presentation on a case study that will both be graded	25
Others		

Assessment comments

Students are required to obtain a final grade of at least 5.0 out of 10 to pass this subject. However, each of the three main parts making up the assessment (theory, case studies and lab sessions) can be compensated among them getting a grade of at least 4.0. Students passing any of the three parts (theory, case studies and lab sessions) are given the opportunity to keep this mark for the two grading opportunities (January and July), being only examined of those parts which they failed. However, all the teaching-learning process of this subject is based on the idea of being developed in the current term. This means that for successive terms the student is suppossed to fullfill all the assignments scheduled for those specific terms.
The grade "No Show" will be given only to those students who have not participated in more than 20% of the activities being assessed during the term.

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Sources of information	
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Complementary	- MELÉNDEZ, B. (1999). Tratado de Paleontología. . Consejo Superior de Investigaciones Científicas - MCNAMARA, K., LONG, J., (1998). 1998. The Evolution Revolution. John Wiley & Sons, Chichester - ROGERS, J.J.W. (1993). A History of the Earth. Cambridge University Press, Cambridge - ANGUITA, F. (2002). Biografía de la Tierra. Editorial Aguilar, Madrid - GOULD, S. J. (1993). El Libro de la Vida. Editorial Crítica, Barcelona - FUTUYMA, D. J. (2009). Evolution. Sinauer Associates - SKELTON, P. (1993). Evolution. A Biological and Palaeontological Approach. Addison Wesley Longman - - (-). Fósil. Revista de Paleontología. http://www.fosil.cl - LEVINTON, J. S. (2001). Genetics, Paleontology, and Macroevolution. Cambridge University Press - DOMÈNECH, R. & MARTINELL, J. (1996). Introducción a los Fósiles. Masson - CLARKSON, E. N. K. (2001). Invertebrate Palaeontology and Evolution. Blackwell Science, Oxford - GOULD, S. J. (1992). La Flecha del tiempo : mitos y metáforas en el descubrimiento del tiempo geológico. Alianza Editorial, Madrid - FORTEY, R. (1999). La Vida: Una Biografía no Autorizada. Editorial Taurus, Madrid - CONDIE, K.C., SLOAN, R.E. (1998). Origin and Evolution of Earth. . Prentice-Hall, Inc., New Jersey - BRENCHLEY, P. J. & HARPER, D. A. T. (1998). Palaeoecology: Ecosystems, Environments and Evolution. Chapman & Hall, London

Recommendations
Subjects that it is recommended to have taken before
Botánica/610212102 Xeoloxía/610212108 Zooloxía/610212205 Ecoloxía/610212301 Xenética/610212303
Subjects that are recommended to be taken simultaneously
Xenética Evolutiva/610212621 Bioloxía do Desenvolvemento/610212605 Ecoloxía de Comunidades e Conservación/610212615 Historia da Terra/610212624
Subjects that continue the syllabus

Xenética Evolutiva/610212621
Bioloxía do Desenvolvemento/610212605
Historia da Terra/610212624
Other comments
Students having specific questions or want to discuss class materials are always welcome during the lecturer's office hours. It is very important that they communicate any kind of problem affecting their class performance, ability to take exams or class attendances, especially in the case of students from overseasIf you have specific questions or want to discuss class material, I am more than happy to meet with you and help. I cannot be your personal tutor, however it is important that you communicate to me any problems you are having that may affect your class performance, your ability to take an exam, or your class attendance.