UNIVERSIDADE DA CORUÑA

Teaching Guide				
Identifying Data				2019/20
Subject (*)	Paleobiology		Code	610G02043
Study programme	Grao en Bioloxía			
Descriptors				
Cycle	Period	Year	Type	Credits
Graduate	1st four-month period	Fourth	Optional	6
Language	SpanishEnglish			
Teaching method	Face-to-face			
Prerequisites				
Department	Física e Ciencias da Terra			
Coordinador	Bao Casal, Roberto	E-mail	roberto.bao@udc.es	
Lecturers	Bao Casal, Roberto Blanco Calvo, Luis Alejandro	E-mail	roberto.bao@udc.es alejandro.blancoc@udc.es	
Web	campusvirtual.udc.es/moodle/			
General description	Paleobiology studies biological processes occurring at geological time scales. After introducing the main features of the fossil record, other aspects, such as the analysis of organic form, the role of the fossil record on the development of modern Evolutionary Theory, or the analysis of paleoecological and paleobiogeographical processes from an evolutionary prespective are considered. An specific section is reserved for an overview of the evolution of biodiversity over geologic time, establishing the different relationships that allow us to understand our planet as a system. The subject has a strong conceptual focus, leaving more descriptive issues (Systematic Paleontology) for the laboratory sessions.			

Study programme competences / results	
Code	Study programme competences / results
A1	Recoñecer distintos niveis de organización nos sistemas vivos.
A2	Identificar organismos.
A3	Recoñecer, obter, analizar e interpretar evidencias paleontológicas.
A4	Obter, manexar, conservar e observar especímenes.
A29	Impartir coñecementos de Bioloxía.
B1	Aprender a aprender.
B2	Resolver problemas de forma efectiva.

Learning outcomes			
Learning outcomes	Study programme competences / results		
To understand the concept of deep (geologic) time	A3 A29	B1	
To understand the processes of fossilization and the biases of the fossil record as an indicator of ancient biospheres	A2	B1	
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	B1 B2	
To expand our understanding of Evolutionary Theory from a multidisciplinary perspective	A3	B1 B2	
To know the fossil groups that make up the fossil record and their practical uses	A1 A2 A3 A4	B1 B2	
To identify the main bioevents in the history of the Earth, their causes and aftermath	A2 A3	B1 B2	

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 A29	B1 B2	

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 The quality of the fossil record
SECTION-3.	MORPHOLOGICAL ANALYSIS
Lesson 3. 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 4. 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 5. 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-4.	EVOLUTIONARY PALEONTOLOGY
Lesson 6. 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 7. Speciation	13.1 Introduction 13.2 Species concepts 13.3 Modes of speciation 13.4 The problem of species concept in Paleontology

Lesson 8. 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 9. Paleobiogeography	16.1 Introduction 16.2 Dispersal biogeography 16.3 Paleogeography and paleoclimatology 16.4 Vicariance biogeography 16.5 Biogeographic patterns and extinctions
Lesson 10. Evolutionary Paleoecology	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
SECTION-5.	BIOSTRATIGRAPHY
Lesson 11. Time and Geology	4.1 Dating methods 4.2 The geologic time scale
SECTION-6.	HISTORY OF LIFE
Lesson 12. 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 13. 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 14. Mass extinction events	7.1 Mass extinctions. Causes and their aftermath. 7.2 The end-Permian extinction. 7.3 The end-Cretaceous extinction.
Lesson 15. 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.

Planning				
Methodologies / tests	Competencies / Results	Teaching hours (in-person & virtual)	Student?s personal work hours	Total hours
Guest lecture / keynote speech	A3 A29 B1 B2	22	66	88
Workshop	A1 A2 A3 A4 A29 B1 B2	8	12	20
Laboratory practice	A1 A2 A3 A4 A29 B1 B2	12	18	30
Objective test	A1 A2 A3 A4 A29 B1 B2	2	8	10
Personalized attention		2	0	2
(*)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	Lectures will be devoted to topics related to principles and problems in paleontology, as well as to the history of life on Earth. Students are expected to take their own notes. Reading assignments from specific topics delivered during the lectures are also expected to be completed.
Workshop	Workshops aim to introduce the students to basic concepts on taphonomy and systematics handling fossil specimens. Students will be required to take their own notes and answer quizzes. Attendance to the workshops is compulsory to pass the course.
Laboratory practice	Laboratory sessions will extend on the recognition of the basic morphological features of the main groups of fossils, as well as on the 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 to pass the course.
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 Guest lecture / keynote speech Objective test	Attendance to tutorials is expected, especially for those aspects showing greater difficulty, such as quizzes solving, tests, or workshop/laboratory observations. Part-time students not capable of attending to the workshops and/or lab sessions are eligible to get an exemption of these compulsory tasks in the scheduled programme. They will however be required to handle the fossil specimens from the UDC collection and answer all the quizzes in a different schedule adapted to their job obligations.

Assessment			
Methodologies	**Competencies / Results**	**Description**	**Qualification**
Workshop	A1 A2 A3 A4 A29 B1 B2	Continuous assessment using quizzes involving multiple choice, matching, true-false questions, fill in the blank questions or short answer and essay questions on some of the main fossil groups. These quizzes make up 15% of the final grade	15
Laboratory practice	A1 A2 A3 A4 A29 B1 B2	Continuous assessment using quizzes involving multiple choice, matching, true-false questions, fill in the blank questions or short answer and essay questions on some of the main fossil groups (15% of final grade). Students are also expected to take an exam on fossil identification de visu (another 10% of final grade)	25
Guest lecture / keynote speech	A3 A29 B1 B2	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 60% of the final grade.	60
Objective test	A1 A2 A3 A4 A29 B1 B2	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., lectures 65%, workshops 25% or lab sessions 25%) that they failed	0
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 (lectures, workshops and lab sessions) can be compensated among them getting a grade of at least 4.0. Students passing any of the three parts (lectures, workshops 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.
Under exceptional
justified reasons, such as part-time learning, or students with special
educational needs, specific assessments could be undertaken.

The grade ?no show? will
be given only to those students who have not participated in more than 20% of
the assessed activities during the term.

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. The before mentioned instructions also apply for part-time students.

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 obtaining a mark
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
(January and July) grading opportunities, 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 supposed to fullfill all the assignments
sheduled for these specific terms.
The
grade ?no show? will be given only to those students who have not participated

in more than 20% of the assessed activities during the term.

Students are required

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 obtaining a mark 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 (January and July) grading opportunities, 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 supposed to fullfill all the assignments sheduled for these specific terms.
The
grade ?no show? will be given only to those students who have not participated in more than 20% of the assessed activities during the term.

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 obtaining a mark 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 (January and July) grading opportunities, 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 supposed to fullfill all the assignments sheduled for these specific terms.
The
grade ?no show? will be given only to those students who have not participated in more than 20% of the assessed activities during the term.

Sources of information	
Basic	- PROTHERO, D. R. (2013). Bringing Fossils to Life. An Introduction to Paleobiology. Columbia University Press, New York - FOOTE, M. & MILLER, A.I. (2007). Principles of Paleontology. W. H. Freeman, New York - FREEMAN, S. & HERRON, J.C. (2013). Evolutionary Analysis. Preason Prentice Hall - BENTON, M. J. & HARPER, D. A. T. (2009). Introduction to Paleobiology and the Fossil Record. Wiiey-Blackwell - COWEN, R. (2013). History of Life. Blackwell Science, Oxford. - LEVIN, H. L. (2010). The Earth through Time. John Wiley & Sons, Hoboken, New Jersey - WICANDER, R. & MONROE, J. S. (2012). Historical Geology. Evolution of Earth and Life through Time. Thompson Learning, Belmont - REGUANT, S. (2005). Historia de la Tierra y de la Vida. Editorial Ariel, Barcelona - BRIGGS, D. E. G. & CROWTHER, P. R. (2003). Palaeobiology II. Blackwell Science - STANLEY, S. M. (2009). Earth System History. Freeman and Company, New York - MARTIN, R. (2012). Earth's Evolving Systems: The History of Planet Earth. Jones & Bartlett Learning, Sudbury - CLOWES, C. et al. (). Palaeos: Life through deep time. http://www.palaeos.com - U. of California Paleontology Museum (). Geology Wing/Tree of Life. http://www.ucmp.berkeley.edu/exhibit/geology.html - Varios autores (). Tree of Life Web Project. http://tolweb.org/tree/phylogeny.html <u>RECURSOS WEB</u>http://www.palaeos.comhttp://www.ucmp.berkeley.edu/exhibit/geology.htmlhttp://tolweb.org/tree/phylogeny.htmlRECURSOS WEBhttp://www.palaeos.comhttp://www.ucmp.berkeley.edu/exhibit/geology.htmlhttp://tolweb.org/tree/phylogeny.html
Complementary	- DOMÈNECH, R. & MARTINELL, J. (1996). Introducción a los Fósiles. Masson - BRENCHLEY, P. J. & HARPER, D. A. T. (1998). Palaeoecology: Ecosystems, Environments and Evolution. Chapman & Hall, London - CLARKSON, E. N. K. (2001). Invertebrate Palaeontology and Evolution. Blackwell Science, Oxford - LEVINTON, J. S. (2001). Genetics, Paleontology, and Macroevolution. Cambridge University Press - SKELTON, P. (1993). Evolution. A Biological and Palaeontological Approach. Addison Wesley Longman - FUTUYMA, D. J. & KIRKPATRICK, M. (2017). Evolution. Oxford University Prees - - (-). Fósil. Revista de Paleontología. http://www.fosil.cl - ANGUITA, F. (2002). Biografía de la Tierra. Editorial Aguilar, Madrid - FORTEY, R. (1999). La Vida: Una Biografía no Autorizada. Editorial Taurus, Madrid - GOULD, S. J. (1992). La Flecha del tiempo : mitos y metáforas en el descubrimiento del tiempo geológico. Alianza Editorial, Madrid - GOULD, S. J. (1993). El Libro de la Vida. Editorial Crítica, Barcelona - JAIN, S. (2016). Fundamentals of Invertebrate Palaeontology: Macrofossils. Springer - BOTTJER, D. J. (2016). Paleoecology: Past, Present and Future. Wiley - MILSOM, C. & RIGBY, S. (2010). Fossils at a Glance. Wiley-Blackwell

Recommendations
Subjects that it is recommended to have taken before

Geology/610G02004
Physical Geography/610G02006
Genetics/610G02019
Population Genetics and Evolution/610G02021
Plant Systematics: Cryptogamia/610G02024
Plant Systematics: Phanerogamia/610G02025
Zoology I/610G02031
Zoology II/610G02032
Ecology I: Individuals and Ecosystems/610G02039
Ecology II: Populations and Communities/610G02040
Subjects that are recommended to be taken simultaneously
Animal Biodiversity and the Environment/610G02033
Subjects that continue the syllabus
Developmental Biology/610G02010
Functional Adaptations of Animals in the Environment/610G02037
Other comments
Students having specific questions or wanting to discuss class materials are always welcome during the lecturer's office hours. It is highly recommended that they communicate any kind of problem affecting their class performance, ability to take tests or class attendances, especially in the case of foreign studentsIf 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.

(*)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.