UNIVERSIDADE DA CORUÑA

Teaching Guide				
Identifying Data				2016/17
Subject (*)	Xenética de poboacións e evolución		Code	610G02021
Study programme	Grao en Bioloxía			
Descriptors				
Cycle	Period	Year	Type	Credits
Graduate	2nd four-month period	Third	Obligatoria	6
Language	SpanishGalicianEnglish			
Teaching method	Face-to-face			
Prerequisites				
Department	Bioloxía Celular e Molecular			
Coordinador	Naveira Fachal, Horacio	E-mail	horacio.naveira.fachal@udc.es	
Lecturers	Naveira Fachal, Horacio Vila Taboada, Marta	E-mail	horacio.naveira.fachal@udc.es marta.vila.taboada@udc.es	
Web				
General description	Introductory course to population genetics and evolution, dealing with the forces that act on gene frequencies in populations, the interactions between genotypes and environment that shape phenotypes, and the patterns of evolution of populations and species.			

Study programme competences	
Code	Study programme competences
A7	Reconstruír as relacións filogenéticas entre unidades operacionales e pór a proba hipóteses evolutivas.
A12	Manipular material xenético, realizar análises xenéticas e levar a cabo asesoramento xenético.
A18	Levar a cabo estudos de produción e mellora animal e vexetal.
A21	Deseñar modelos de procesos biolóxicos.
A24	Xestionar, conservar e restaurar poboacións e ecosistemas.
A27	Dirixir, redactar e executar proxectos en Bioloxía.
B1	Aprender a aprender.
B2	Resolver problemas de forma efectiva.
B3	Aplicar un pensamento crítico, lóxico e creativo.
B4	Traballar de forma autónoma con iniciativa.
B5	Traballar en colaboración.
B6	Organizar e planificar o traballo.
B7	Comunicarse de maneira efectiva nunha contorna de traballo.

Learning outcomes			
Learning outcomes	Study programme competences		
Capacity to interpret and to analyze the biological problems, as well as the human nature itself, from an evolutionary perspective	A7 A12 A18 A21	B1 B2 B3 B4 B5 B6 B7	

Choice of the techniques and methods more adequate to tackle the study of a specific evolutionary problem	A7 A12 A18 A24	B1 B2 B3 B4 B5 B6 B7	
Use of the genetic information to manage, to preserve and to restore populations.	A7 A12 A18 A21 A24 A27	B1 B2 B3 B4 B5 B6 B7	

Contents	
Topic	**Sub-topic**
1.- GENERAL INTRODUCTION.	Genetic variation and its quantification. Genotype and phenotype. Evolutionary units: domains, supradomains and multiprotein factories. Adaptations, exaptations and spandrels.
2.- QUANTITATIVE GENETICS.	Continuous, discontinuous and threshold characters. Breeding value and genotypic value of a genotype. Environmental value. Environmental sensitivity of a genotype. Components of phenotypic variance. Heritability. Estimation of the minimum number of loci underlying a quantitative trait (QTL). Mapping of QTLs.
3.- CONSEQUENCES OF REPRODUCTIVE SYSTEMS AND TYPES OF MATING ON THE ORGANIZATION OF GENETIC VARIATION.	Maintenance of genetic variation in populations with sexual reproduction and random mating: Hardy-Weinberg law (H-W); deviations from H-W expectations. Effects of asexual reproduction and non-random mating on genotype frequencies: parthenogenesis; self-fertilization; inbreeding and relatedness coefficients; regular systems of inbreeding; phenotypic assortative mating.
4.- RANDOM DRIFT OF GENE FREQUENCIES IN SMALL POPULATIONS.	Sampling of gametes and random walk of gene frequencies. Wright-Fisher model. Dispersion of gene frequencies among subpopulations. Rate of fixation within subpopulations and genomes. Effective population size. Founder effects and population bottlenecks. Wahlund's effect.
5.- MUTATION AND GENE FLOW.	Classes of mutations: nucleotide substitutions; insertions and deletions; duplications; chromosome rearrangements. Mutation rates. Change in gene frequency due to mutation. The fate of a single mutant. Models of mutation in molecular population genetics. Migration and gene flow. Change in gene frequency due to migration; the island model. Mutation and migration in finite populations.
6.- EFFECTS OF NATURAL SELECTION ON GENE FREQUENCIES AND PHENOTYPES.	Natural selection. Biological fitness. Types of selection. Haploid and diploid basic models of selection. Hard vs soft selection. Balanced polymorphisms kept by constant selection coefficients. Selection on quantitative traits. Correlated response to selection.
7.- GAMETIC DISEQUILIBRIUM AND RECOMBINATION.	Linkage groups. Quantifying linkage disequilibrium. Randomization effect of recombination. Factors that influence disequilibrium. Evolutionary advantages of recombination. Interactions between non-allelic genes in the determination of fitness. Genetic coadaptation. Horizontal transmission. Promiscuous proteins. Gene duplications. Recruitment. Modular evolution.

8.- EQUILIBRIUM BETWEEN SELECTION AND OTHER FORCES THAT CHANGE GENE FREQUENCIES.	Mutation-selection balance. The distribution of fitness effects of new mutations. Mutation load: Haldane-Muller principle. Hill-Robertson effect. Muller's ratchet. The degeneration of Y chromosomes. Segregation load. Equilibrium between selection and gene flow.
9.- MEASURING FITNESS IN CONTEMPORARY POPULATIONS.	Fitness components. Changes in gene frequencies over several generations. Changes in gene frequencies within the life cycle. Differences in the distribution of genetic variation before and after the action of selection. Chromosome extraction techniques. Frequent errors and spurious results in the estimation of fitness. Major difficulty faced by attempts to estimate fitness differences among genotypes in natural populations.
10.- VARIATION IN SELECTION COEFFICIENTS.	Evolutionary constraints. Environmental mosaicism. Spatial and/or temporal variation in fitness. Selection, gene flow and clines. Frequency-dependent selection. Antagonistic pleiotropy. Genetic conflicts. Sexual selection. Cooperation, altruism and kin-selection: inclusive fitness.
12.- MOLECULAR FOOTPRINTS OF NATURAL SELECTION AND STATISTICAL METHODS FOR TESTING THE NEUTRAL HYPOTHESIS.	Models of DNA evolution. Limits of nucleotide divergence. Estimates of the number of nucleotide substitutions. Substitution rates. Pseudogenes. Direct effects of selection on nucleotide polymorphism and divergence. The importance of recombination: selective sweep and background selection. Estimators of the population mutation parameter. Statistical tests.
13.- MOLECULAR PHYLOGENIES.	Cladograms and phylograms. Coalescence theory. Monophyletic, paraphyletic and polyphyletic taxa. Gene trees and species trees. Methods of molecular phylogenetics. The human evolutionary tree.
TEMA 13.- FILOXENIAS MOLECULARES.	Cladogramas e filogramas. Teoría da coalescencia. Relacións monofiléticas, parafiléticas e polifiléticas. Árbores de xenes e árbores de especies. Métodos de filoxenética molecular. A árbore evolutiva da especie humana.
14.- ORIGINS OF SPECIES.	Concepts of species. Why are there so many species? Modes of speciation. Speciation and structure of fitness topographies. Evolution of genetic incompatibilities of hybrids. Rules of speciation. Punctuated equilibria: an alternative to phyletic gradualism
15.- MACROEVOLUTION	The history of biodiversity. Rates of species origination and extinction. Biogeography. The species concept in paleontology. Using phylogeny to reconstruct the deep past. Adaptive radiations. The origin of animal body plans: Ediacaran biota. Mass extinctions. Human-driven extinctions (the "Sixth Mass Extinction").

Planning				
Methodologies / tests	Competencies	Ordinary class hours	Student?s personal work hours	Total hours
Introductory activities	B1 B4 B5 B6	1	0	1
Guest lecture / keynote speech	A7 A12 A18 A24 B1 B3 B4 B6	15	45	60
Problem solving	B2	6	6	12
ICT practicals	A7 A21 B2 B4	15	15	30
Directed discussion	B1 B2 B3 B7	1	0	1
Collaborative learning	A27 B1 B3 B5 B7	7	35	42
Objective test	A7 A12 A18 A21 A24 B1 B2	3	0	3
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
Introductory activities	Profesor.- Presenta a guía docente da materia, aclara dúbidas, organiza os alumnos para as actividades. Alumno.- Toma notas, formula dúbidas e cuestións.
Guest lecture / keynote speech	Profesor.- Explica os fundamentos teóricos Alumno.- Observa, asimila e toma notas. Formula dúbidas e cuestións. Memoriza. Le os textos recomendados.
Problem solving	Profesor.- Formula problemas e orienta para a súa resolución. Alumno.- Traballa individualmente ou en grupo, busca información e resolve as cuestións formuladas
ICT practicals	Profesor. - Presenta os obxectivos, prepara o material e o equipo, expón os métodos, proporciona un guión, asiste aos alumnos. Alumno. - Experimenta, analiza e elabora unha memoria
Directed discussion	Titoría en grupo moi reducido na que se discutirán a resolución de exercicios e temas de divulgación científica relacionados coa materia.
Collaborative learning	(profesor) Asigna traballos. Instrúe sobre ferramentas. Orienta e resolve dúbidas. (alumno) Traballa cos seus compañeiros na realización das tarefas asignadas polo profesor.
Objective test	Profesor. - Formula preguntas e valora as respostas dos alumnos Alumno. - Consulta os seus materiais de apoio e responde ás preguntas

Personalized attention	
Methodologies	**Description**
Directed discussion Collaborative learning Guest lecture / keynote speech Problem solving ICT practicals	Every student will have 1 hour of obligatory tuition, with the objective of detecting possible dysfunctions of the teaching program and designing appropriate corrective actions.

Assessment			
Methodologies	**Competencies**	**Description**	**Qualification**
Directed discussion	B1 B2 B3 B7	Na última sesión de seminario, os alumnos realizarán unha proba mixta (test + problemas) sobre os contidos tratados nos tres seminarios anteriores.	10
ICT practicals	A7 A21 B2 B4	Realización de varios exercicios de xenética evolutiva cun ordenador persoal, empregando os programas informáticos utilizados nas prácticas. É imprescindible obter polo menos 15 puntos nesta proba para aprobar a materia. Nesta actividade avaliarase a adquisición das competencias A7, A21, A24 e A27.	25
Objective test	A7 A12 A18 A21 A24 B1 B2	Conxunto de preguntas de distinto tipo (alternativa múltiple, resposta breve, completar, asociación, etc) relacionadas con calquera dos contidos do temario. Corresponde ao exame final da materia. É imprescindible obter polo menos 35 puntos nesta proba para aprobar a materia. A proba desenvólvese en dúas fases. A primeira delas non é presencial, e consiste en unha serie de cuestionarios na plataforma Moodle, aos que se debe dar resposta en datas e horas prefixadas ao longo do curso. A contribución desta fase á proba é de un máximo de 25 puntos. A segunda fase é un exame presencial con preguntas test de alternativa múltiple, ao que pode levarse todo o material de apoio que se desexe, incluidos ordeadores persoais, pero na que non se permitirá o acceso a INTERNET. A contribución acumulada desta segunda fase xunto ca da primeira á nota final da materia é de un máximo de 65 puntos. Nesta actividade avaliarase a adquisición das competencias A7, A12, A18, A21, A24 e A27.	65

Assessment comments
Considerararanse PRESENTADOS nas actas da materia todos aquele alumnos que se presenten ao exame de prácticas ou á segunda fase da proba obxectiva. A nota final en actas dos alumnos que non acadaran nas prácticas ou na proba obxectiva a nota mínima para aprobar a materia, pero cuxa puntuación acumulativa fose superior a 50, será un 4.9 (SUSPENSO). Na segunda oportunidade utilizarase a mesma metodoloxía de avaliación que na primeira.

Sources of information	
Basic	- Fontdevila, A., y Moya, A. (2003). Evolución: Origen, Adaptación y Divergencia de las Especies. Síntesis - Fontdevila, A., y Moya, A. (2007). Introducción a la Genética de Poblaciones. . Síntesis - Herron, J. D., and Freeman, S. (2014). Evolutionary Analysis. . Pearson - Futuyma, D. (2006). Evolutionary Biology. Sinauer - Hamilton, M. (2009). Population Genetics. Wiley-Blackwell - Hartl, D.L. and Clarck, A.G. (2007). Principles of Population Genetics. Sinauer Associates - Hedrick, P.W. (2010). Genetics of Populations.. Jones & Bartlett - Zimmer, C. and Emlen, D. (2012). Evolution: Making sense of life. Roberts and Company Publishers - Lemey, P., Salemi, M., and Vandamme, A-M (2009). The Phylogenetic Handbook. Cambridge University Press
Complementary	- Avise, J. C. (2006). Evolutionary Pathways in Nature. A Phylogenetic Approach. . Cambridge Univ. Press. - Barton, N. (2007). Evolution. Cold Spring Harbor Lab. Press. - Bromham, L. (2008). Reading the Story in DNA: A Beginners Guide to Molecular Evolution. . Oxford Univ. Press. - Coyne, J. A. (2009). Why Evolution is True. Viking - Dawkins, R. (1996). The blind watchmaker.. W. W. Norton & Co. - Ridley, M. (2004). Evolution. Blackwell - Sampedro, J. (2007). Deconstruyendo a Darwin: Los Enigmas de la Evolución a la Luz de la Nueva Genética.. Síntesis

Recommendations
Subjects that it is recommended to have taken before
Estatística/610G02005 Xenética/610G02019 Xenética molecular/610G02020
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.