

		Teachin	g Guide			
	Identifying	J Data				2021/22
Subject (*)	Population Genetics and Evolution				Code	610G02021
Study programme	Grao en Bioloxía					
	-	Desci	riptors			
Cycle	Period Year Type Cred			Credits		
Graduate	2nd four-month period	Th	iird		Obligatory	6
Language	SpanishGalicianEnglish					
Teaching method	Face-to-face					
Prerequisites						
Department	Bioloxía					
Coordinador	Naveira Fachal, Horacio		E-mail		horacio.naveira.	fachal@udc.es
Lecturers	Naveira Fachal, Horacio		E-mail		horacio.naveira.	fachal@udc.es
	Vila Sanjurjo, Antón				anton.vila@udc.	es
Web	campusvirtual.udc.gal/course/view	.php?id=1408	37			
General description	Introductory course to population g	enetics and e	evolution, dealing	g with the	forces that act of	on gene frequencies in
	populations, the interactions betwe	en genotypes	s and environme	ent that sh	nape phenotypes	s, and the patterns of evolution of
	populations and species.					
Contingency plan	Adaptations that will be carried out	in teaching a	nd evaluation, i	n a scena	rio of non-prese	nce due to a new outbreak of the
	pandemic, or in case that due to space problems in the classrooms it is not possible to guarantee 100% of presentiality for					
	the expository teaching:					
	1 In case of capacity problems in	the spaces d	esignated for the	e realizat	ion of face-to-fac	e activities, additional spaces will
	be reserved in which students can	follow the act	ivities through th	he Teams	SUDC platform.	In the case of practical activities,
	the groups will be divided to adapt	to the capacit	tv of the laborate	orv or cor	nputer room.	· · · · · · · · · · · · · · · · · · ·
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	2 Modifications in the contents					
	No changes will be made.					
	3 - Methodologies					
	The classes and other activities the	at cannot be c	leveloped in the	classroo	m due to the for	reseeable measures of social
	distancing will be developed telem	atically through	ab the platform	Teams II	DC for which a s	specific team of the subject will be
	created Visits to external laborator	ries integrate	d in the practice	s of the s	subject will be su	ispended
		nes, integrate			Subject, will be st	
	4 - Personalized attention to stude	nte				
	t will be partiad out by a mail and Teama					
	It will be carried out by e-mail and	reams.				
	5 Modifications in the evaluation					
	If necessary all the tests will be tel	lematic throu	ah Teams and M	Moodle M	ith the webcame	sactivated
	in necessary, an me tests will be telemane, mough reams and moude, with me webcants activated.					
	6 Modifications to the hibliography	or webaraab	W			
		or webyraph	'Y			
	None.					

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

Contents			
Торіс	Sub-topic		
1 GENETIC VARIATION	Different kinds of genetic variation and their quantification. The National Center for		
	Biotechnology Information (NCBI) databases. The 1000 genomes project of human		
	variation. Genome browsers (Ensembl). Genotype and phenotype.		
2 MACROEVOLUTION	Evolution above the species level. Timeline of life on earth. The three domains of life.		
	Using phylogenies to reconstruct the deep past. Diversification of eukaryotes. The		
	species concept in paleontology. Patterns of macroevolution. Mass extinctions.		
	Differences among clades in species diversity. The evolution of complex biological		
	structures through the fossil record.		
3THE BUILDING OF EVOLUTIONARY MODULES	Promiscuous proteins; molecular machines; modular evolution of proteins.		
	Evolutionary tinkering. Biochemical construction kits. Adaptations, exaptations and		
	spandrels. Evo-devo: recycling networks. Retrograde and intercalary evolution. Gene		
	duplications. Recruitment. Horizontal transmission. Linkage groups. Randomization		
	effect of recombination. Genetic coadaptation. Supergenes.		



4 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
5 THE ORIGINS OF SPECIES	Concepts of species. Main questions related to speciation. Intrinsic reproductive
	barriers of isolation. Speciation and fitness landscapes: the shifting-balance theory.
	Modes of speciation. Adaptive radiations. Magic traits. Evolution of hybrid genetic
	incompatibilities. General rules of speciation and evolutionary diversification. Phyletic
	and cladistic evolution in the fossil record.
6 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. Genome-wide
	association studies (GWAS).
7 CONSEQUENCES OF REPRODUCTIVE SYSTEMS AND	Maintenance of genetic variation in populations with sexual reproduction and random
TYPES OF MATING ON THE ORGANIZATION OF GENETIC	mating: Hardy-Weinberg law (H-W); deviations from H-W expectations. Effects of
VARIATION	asexual reproduction and non-random mating on genotype frequencies:
	parthenogenesis; self-fertilization; inbreeding and relatedness coefficients; regular
	systems of inbreeding; phenotypic assortative mating. Genetic admixture.
8 RANDOM GENETIC CHANGES IN POPULATIONS OF	Sampling of gametes and random walk of gene frequencies. Wright-Fisher model.
SMALL SIZE	Dispersion of gene frequencies among subpopulations. Rate of fixation within
	subpopulations and genomes. Effective population size. Founder effects and
	population bottlenecks. Wahlund effect.
9 MUTATION AND MIGRATION	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.
10 EFFECTS OF NATURAL SELECTION ON	Natural selection. Biological fitness. Types of selection. Selection on quantitative traits.
PHENOTYPES AND GENE FREQUENCIES	Measuring multivariate selection. Selection on correlated characters. Case study: the
	genetic basis of adaptation to high altitude in humans. Good genes or bad genes?
	Haploid and diploid basic models of selection. Polymorphisms maintained by constant
	selection coefficients. Fitness estimation. Fitness landscapes.
11 COMBINED ACTION OF SELECTION AND OTHER	Mutation-selection balance. The role of recombination: Muller's ratchet and the
EVOLUTIONARY FORCES. VARYING SELECTION	degeneration of Y chromosomes. Equilibrium between selection and gene flow; gene
COEFFICIENTS	clines. Too much heterosis: segregational load. Negative frequency-dependent
	selection. Spatial and temporal variation in fitness: coarse grained vs fine grained
	environments. Antagonistic pleiotropy. Fitness trade-offs.
12 ENGINES OF EVOLUTION	Red Queen dynamics. Interspecies antagonisms. Sexual conflicts. Sexual selection
	vs. natural selection. Parent-offspring conflicts. Intergenomic conflicts: cytoplasmic
	incompatibility. Intragenomic conflicts: selfish genetic elements.
13 THE NEUTRAL THEORY OF MOLECULAR	The neutral theory of molecular evolution. Molecular clocks. Models of DNA evolution.
EVOLUTION. MOLECULAR FOOTPRINTS OF NATURAL	Limits of nucleotide divergence. Estimates of the number of nucleotide substitutions.
SELECTION	Substitution rates. Pseudogenes. Direct effects of selection on nucleotide
	polymorphism and divergence. The importance of recombination: selective sweep and
	background selection. Selection and demographic history can leave similar footprints
	on DNA variation. Statistical tests.

Planning						
Methodologies / tests	Competencies	Ordinary class	Student?s personal	Total hours		
		hours	work hours			



Introductory activities	B1 B4 B5 B6	1	0	1
Guest lecture / keynote speech	A7 A12 A18 A24 B1	18	36	54
	B3 B4 B6			
Problem solving	B2	6	12	18
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	3	0	3
	B1 B2			
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 /	Profesor Explica os fundamentos teóricos			
keynote speech	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	Discusión de textos asignados a principio do curso e resolución de exercicios relacionados.			
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	Every student will have 1 hour of obligatory tuition, with the objective of detecting possible dysfunctions of the teaching				
Collaborative learning	program and designing appropriate corrective actions.				
Guest lecture /					
keynote speech					
Problem solving					
ICT practicals					

Assessment				
Methodologies	Competencies	Description	Qualification	
Directed discussion	B1 B2 B3 B7	1 hour exam (test + exercises) related to the topics dealt with in the seminars.	15	
ICT practicals	A7 A21 B2 B4	Practical exercises of bioinformatics. Compulsory: to avoid failing the subject, every student should obtain at least 15 points in this exam.	25	



Objective test	A7 A12 A18 A21 A24	Critical review of a scientific manuscript (value = 10), plus regularly spaced	60
	B1 B2	multiple-choice tests (cumulative value = 15), plus final theoretical exam consisting	
		both of multiple-choice tests and populations genetics exercises (cumulative value =	
		35).	
		Compulsory: to avoid failing the subject, every student should obtain at least 35 points	
		in this part of the assessment.	

Assessment comments

Official withdraw from the course is only possible if the student attends neither the final theoretical nor the practical exam.

The final grade of the students who did not reach the minimum grade to pass the course in the practical or the objective test, but whose cumulative score happened to be higher than 50, will be a 4.9 (FAILED).

In the second opportunity, the same evaluation methodology will be used as in the first one.

In the event that a student, for duly justified reasons, cannot attend the official exams of the subject, he/she will be examined orally. If he/she is unable to take the continuous evaluation tests, or if he/she does not obtain the maximum possible points with these tests, he/she may take an additional block of exercises in the official exam, in order to recover the points lost.

The fraudulent performance of the evaluation tests or activities will directly imply the grade of FAILED (0) in the subject at the corresponding opportunity.

Sources of information	
Basic	- Hartl, D. L. (2020). A primer of population genetics and genomics. OUP Oxford
	- Cutter, A. D. (2019). A primer of molecular population genetics. OUP Oxford
	- Zimmer, C. and Emlen, D. (2015). Evolution: Making sense of life. Roberts and Company Publishers
	- Shubin, N. (2015). Tu pez interior. Capitán Swing
	- Lane, N (2018). Power, Sex, Suicide. OUP Oxford
	- Hahn, M. W. (2018). Molecular Population Genetics. OUP USA
	- Caballero, A. (2017). Genética Cuantitativa. Síntesis
	- Hedrick, P.W. (2011). Genetics of Populations Jones & amp; Bartlett
	- Herron, J. D., and Freeman, S. (2014). Evolutionary Analysis Pearson
	- DeSalle, R. (2013). Phylogenomics: A primer. Routledge
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
	- Ridley, M. (2004). Evolution. Blackwell
	- Sampedro, J. (2007). Deconstruyendo a Darwin: Los Enigmas de la Evolución a la Luz de la Nueva Genética
	Síntesis
	- Fontdevila, A., y Moya, A. (2003). Evolución. Origen, adaptación y divergencia de las especies Síntesis
	- Fontdevila, A., y Moya, A. (1999). Introducción a la genética de poblaciones. Síntesis

Recommendations
Subjects that it is recommended to have taken before
Statistics/610G02005
Genetics/610G02019
Molecular Genetics/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.