



Teaching Guide

| Identifying Data | | | | 2014/15 |
|----------------------------|--|---------------|---|----------------|
| 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 | | | |
| Prerequisites | | | | |
| Department | Bioloxía Celular e Molecular | | | |
| Coordinador | Naveira Fachal, Horacio | E-mail | horacio.naveira.fachal@udc.es | |
| Lecturers | Nantón Varela, Ana Naveira Fachal, Horacio Vila Taboada, Marta | E-mail | ana.nanton@udc.es horacio.naveira.fachal@udc.es marta.vila.taboada@udc.es | |
| Web | | | | |
| General description | Curso de introdución á Xenética de Poboacións e a Evolución, no que se presentan e discuten as distintas forzas que actúan sobre as frecuencias xénicas nas poboacións, as relacións entre xenotipos e ambientes que dan forma aos fenotipos, e os patróns de evolución das poboacións e especies. | | | |

Study programme competences

| Code | Study programme competences |
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| A7 | Reconstruír as relacións filoxenéticas entre unidades operacionais 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. |
| 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. |
| 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 |
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| 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 | C1 C2 C3 C4 C6 C7 |
| 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 | C1 C2 C3 C6 C8 |
| 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 | C1 C2 C3 C4 C6 C8 |

| Contents | |
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| 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. |



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| 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. |
| 11.- THE NEUTRAL AND NEARLY-NEUTRAL THEORIES OF MOLECULAR EVOLUTION | Historical debates about genome levels of heterozygosity. Random sampling genetic drift and natural selection. Selectively neutral or nearly neutral alleles. Evolutionary rates. Molecular evolution versus evolution of shape and function. Predictions of the neutralist hypothesis. Consequences of the near-neutrality of mutations. |
| 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. |
| 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 | Ordinary class hours | Student's personal work hours | Total hours |
|--------------------------------|----------------------|-------------------------------|-------------|
| Introductory activities | 1 | 0 | 1 |
| Guest lecture / keynote speech | 15 | 37.5 | 52.5 |
| Problem solving | 6 | 6 | 12 |
| Collaborative learning | 6 | 27 | 33 |
| Oral presentation | 1 | 2 | 3 |
| ICT practicals | 15 | 15 | 30 |
| Document analysis | 0 | 14.5 | 14.5 |



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| Objective test | 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 |
| Collaborative learning | Profesor. - Asigna traballos. Instrúe sobre ferramentas. Orienta e resolve dúbidas. Alumno. - Traballa cos seus compañeiros na realización das tarefas asignadas polo profesor |
| Oral presentation | Profesor. - Prepara os medios audiovisuais e modera as presentacións. Alumno relator. - Elabora un guión sobre un tema monográfico e expón oralmente, en lingua inglesa. Alumno espectador. - Atende ás presentacións, toma notas, avalía os seus compañeiros con axuda dunha rúbrica. |
| ICT practicals | Profesor. - Presenta os obxectivos, prepara o material e o equipo, expón os métodos, proporciona un guión, asiches os alumnos. Alumno. - Experimenta, analiza e elabora unha memoria |
| Document analysis | Profesor. - Indica fontes documentais Alumno. - Consulta e selecciona información |
| 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 |
| Oral presentation 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 | Description | Qualification |
| Oral presentation | Exposición oral de 5 minutos, en inglés, sobre un tema monográfico asignado polo profesor. A valoración efectuarase mediante unha rúbrica que recolle tanto aspectos formais como de contido, e representará un máximo de 10 puntos. A presentación oral deberá ir acompañada dun pequeno guión descritivo do seu contido, en inglés, con indicación das principais fontes documentais (1 páxina A4, con letra tamaño 12 e como máximo 10 referencias bibliográficas), que terá un valor máximo de 5 puntos. Nesta actividade avaliarase a adquisición das competencias A7, A12, A21 e A24. | 15 |
| Collaborative learning | Varias preguntas de tipo test que deberán responderse ao final de cada sesión de aprendizaxe colaborativa. Nesta actividade avaliarase a adquisición das competencias A7, A12, A18, A21, A24 e A27. | 20 |
| Guest lecture / keynote speech | Dez preguntas relativas a ampliación de contidos expostos nas clases maxistras, que poden enviarse para cualificación en calquer momento do curso. Nesta actividade avaliarase a adquisición das competencias A7, A12, A18, A21 e A24 | 10 |



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| ICT practicals | Realización de varios exercicios de xenética evolutiva cun ordenador persoal, empregando os programas informáticos utilizados nas prácticas. É imprescindible obter polo menos 8 puntos nesta proba para aprobar a materia. Nesta actividade avaliarase a adquisición das competencias A7, A21, A24 e A27. | 15 |
| Objective test | Conxunto de 20-30 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 20 puntos nesta proba para aprobar a materia. Nesta actividade avaliarase a adquisición das competencias A7, A12, A18, A21, A24 e A27. | 40 |

Assessment comments

Consideraranse presentados todos os alumnos que fixesen o exame de prácticas ou a 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).

Sources of information

| | |
|----------------------|---|
| Basic | <ul style="list-style-type: none"> - Fontdevila, A., y Moya, A. (2003). Evolución: Origen, Adaptación y Divergencia de las Especies. Síntesis - Zimmer, C. and Emlen, D. (2012). Evolution: Making sense of life. Roberts and Company Publishers - Freeman, S., and Herron, J. D. (2007). Evolutionary Analysis. . Prentice Hall - Futuyma, D. (2006). Evolutionary Biology. Sinauer - Hedrick, P.W. (2010). Genetics of Populations.. Jones & Bartlett - Fontdevila, A., y Moya, A. (2007). Introducción a la Genética de Poblaciones. . Síntesis - Hamilton, M. (2009). Population Genetics. Wiley-Blackwell - Hartl, D.L. and Clarck, A.G. (2007). Principles of Population Genetics. Sinauer Associates - Lemey, P., Salemi, M., and Vandamme, A-M (2009). The Phylogenetic Handbook. Cambridge University Press |
| Complementary | <ul style="list-style-type: none"> - Sampedro, J. (2007). Deconstruyendo a Darwin: Los Enigmas de la Evolución a la Luz de la Nueva Genética.. Síntesis - Barton, N. (2007). Evolution. Cold Spring Harbor Lab. Press. - Ridley, M. (2004). Evolution. Blackwell - Avise, J. C. (2006). Evolutionary Pathways in Nature. A Phylogenetic Approach. . Cambridge Univ. Press. - Bromham, L. (2008). Reading the Story in DNA: A Beginners Guide to Molecular Evolution. . Oxford Univ. Press. - Dawkins, R. (1996). The blind watchmaker.. W. W. Norton & Co. - Coyne, J. A. (2009). Why Evolution is True. Viking |

Recommendations

Subjects that it is recommended to have taken before

Subjects that are recommended to be taken simultaneously

Subjects that continue the syllabus

Estatística/610G02005

Xenética/610G02019

Xenética molecular/610G02020

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.