FACULTAD DE CIENCIAS

GRADO DE BIOLOGÍA

2024/25 YEAR

EVOLUCIÓN

Course details

Course name: EVOLUCIÓN
Code: 100431
Degree/Master: GRADO DE BIOLOGÍA **Year:** 4
Field: OPTATIVA
Character: OPTATIVA **Duration:** SECOND TERM
ECTS Credits: 6.0 **Classroom hours:** 60
Face-to-face classroom percentage: 40.0% **Study hours:** 90
Online platform: https://moodle.uco.es/

Coordinating teacher

Name: ALONSO MORAGA, MARIA ÁNGELES
Department: GENÉTICA
Office location: EDIFICIO GREGOR MENDEL, 1ª PLANTA, ALA OESTE, CAMPUS RABANALES
E-Mail: ge1almoa@uco.es **Phone:** +34 957 212072

Brief description of the contents

Origin and history of the evolutionary thought.
Study of the variation.
Characterisation and analysis of genes in populations.
Mechanisms and measurement of the evolutionary change.
Phylogenies reconstruction.
Origin of the genetic information.
The speciation.
The biological adaptation.
History of life.

Prerequisites

Prerequisites established in the study plan

The student must have approved the block of 60 credits corresponding to the basic subjects and at least 60 credits of compulsory subjects.

B1 english level required.

Recommendations

None specified.

Study programme

1. Theory contents

Block 1: Origin and history of the evolutionary thought. Changes on Earth up to 1700. The very first evolutionists. Evolution throughout natural selection. Evolutionary theories in the XX century. Synthetic theory of Evolution, other complementary theories. Contributions from Earth's History, Life History, evolution mechanisms, Genetics and Development areas. Evolutionary questions. Quantitative questions. Human questions.

Block 2: Dynamics and distribution models of populations. Why models? Strength of models. Growing, regulation and stabilization models: exponential, logistic, Lotka-Volterra, survival, spatial distributionsand individual survival models. Metapopulation. Non-random distribution in geographical populations: affecting factors. Active and passive transport, labelling, release and capture.

Block 3: Study of the variation. Genetic variation: classic and balanced hypotheses. Parameters in a gene population. Detecting genetic variation using classic methodologies: direct observations, microscope observations, genetic analysis of visible rare mutations, lethality analyses. Detecting variability using molecular methodologies: protein electrophoresis. Variability indexes in a population: polymorphic loci rate, expected heterozygosis. DNA polymorphisms: RFLP, AFLP, RAPDs, SNP. Interspersed elements: LINE, SINE, tandem repeat sequences: satellite, minisatellite, microsatellite. Importance of microsatellite. Nucleic acid sequenciation: history, +/-, Maxam and Gilbert and Sanger methods.

Block 4: Characterization and analyses of gene populations. Methods of characterization. Panmixia. Allele frequencies at equilibrium. Features for diploid and haploid genetic equilibrium; maximum heterozygosity, rare alleles. Finetti parabola. Uses of Hardy-Weinberg equilibrium. Stratification of populations. Significance tests in the populations genetic analysis: Chi 2 test, Fisher exact test, allele frequencies contrast, confidence intervals, type I and II errors.

Block 5: Panmictic and non-panmictic populations. Island model. Random gamete sampling. Finite size. Consequences of dispersion. Variance of allele frequencies. Genetic drift. Inbreeding coefficient. Effective size: bisexual, bisexual with unbalanced sexes, flushes and crashes (bottle neck). Non-random distribution in family size. Assortative mating; incomplete, symmetric, asymmetric, differential. Hieralchical population structure; heterozygosity HI, HS, HT); inbreeding coefficients (FIS, FST, FIT).

Block 6: Measuring evolutionary change. Measurement between populations and individuals. Protein polymorphism and DNA sequences. Genetic identity. Nei distances. Jukes-Cantor distances. Kimura dissimilarity. Alignment of sequences. Alignment cost.

Blok 7: Phylogeny reconstruction. Usefulness of the phylogenies. Phylogenetic trees: structure and terminology. Types of trees: cladograms, additive, utrametric. Pleisomorphism, autapomorphism, synapomorphism. Homoplasy types. Homologous, orthologous and paralogous genes. Methods of phylogeny reconstruction: UPGMA, neighbor joining, maximum parsimony, maximum likelihood. Bootstrap.

Block 8: Origin of the genetic information. Abiogenesis. Reproduction as the base for evolutionary

adaptation. RNA as the organizer of the genetic information.: indicators. Selective model of RNA quasispecies: production of mutants, competence, selection, error threshold. Model of QB ARN virus. Ancestral genetic code. Hypercycles. Abiogenic compartimentation.

Block 9: The speciation. Definitions for the species concept. Geographical theory of gradual speciation: phases, evidences. Distinguishing twin species: morphological, hybrid sterility, chromosomal, antigenic, electrophoretic, DNA variants markers. Distinguishing semispecies: chromosomal, electrophoretic markers; ring-distributed semispecies. Distinguishing subspecies /geographical races: chromosomal, behavioural markers. Reproductive isolation mechanisms: post and pre-zygotic. Quantum/saltational speciation: features and differences between gradual and quantum speciation processes. Mechanisms for saltational speciation. Differences between speciation in plants and animals: physiological, pollination adaptations, chromosomal rearrangements, poliploidization, compilospecies.

Block 10: The biological adaptation. Concept. The environment creates a problem. Ecological niche. The Red Queen paradox. Evaluation of an adaptation: definition of a trait, discovering its function and influence of the adaptation on the carrier fitness. Adaptive picks. Relativity for the concept of adaptation. Evolutionary changes that are not necessarily adaptive.

Block 11: The history of live on earth. Historic story since the moon and earth formation, Compartimentation of replicant sequences. Energy input. The problem of carbon oxidation. New pathways for detoxifying oxygen. Photosynthesis. Complete respiration. Emergence of eukaria: Lynn Margulis theory. The great explosion of variability during the Precambriam: phases. TheBurgess Shale dig. The five big extinctions. Causes for mass extinctions. Self-organized Critical Systems. The punctuated quilibrium theory.

Block 12: Human evolution. Morphological and molecular evidences for the relationship between human and other primates. The hominization process: features. The modern humans: methods to date the human recent history. Mitohcondrial DNA, Y chromosome, nuclear DNA. Unique origin for extant humans. Inconsistency of the fossils records. Hybridation between Neanderthal and sapiens Homo.

Block 13: Evolution and Development. Genome archaeology. Evidences and mechanisms of evolution. Relationship in the different morphs of live. Changes across the time. Geological changes. Correspondence among groups of data. Molecular palaeontology. Homeotic genes, origin of patterns and diversification. Characteristic of the Homeotic genes. Changes in the number of homeotic genes. Changes in the expression of the homeotic genes. The example of Tetrapoda. Homeotic genes in plants. Gene duplication. Deep homology.

2. Practical contents

Session 1.-Using genetic data bases in silico.
Session 2.- Montecarlo simulation of the genetic drift.
Session 3.-Phenotypic variability and genetic parameters of morphological traits in a human population.
Session 4.- Using DNA for identification and filiation control.
Session 5.- Simulation of stochastic and directional processes in gene populations.
Session 6.- Microdifferentiation of *Drosophila* species.

Bibliography

1. Bibliografía básica:
- FREEMAN, S. y HERRON, JC. Evolutionary Analysis. Ed. Prentice Hall. 1998.
- LEWONTIN, R.C. La Base Genética De La Evolución. Ed. Omega, Barcelona. 1979.3
- NEI, M. and KUMAR, S. Molecular Evolution and Phylogenetics. Oxford University Press. 2000.
- PAGE, R.D.M. and HOLMES, E.C. Molecular Evolution. A phylogenetic approach. Blackwell Science Ltd. 1998.

2. Bibliografía complementaria:
- LI, W-S y GRAUR, D. Fundamental of Molecular Evolution. Ed. Sinauer. 1991
- SPIESS, E.B. Genes In Populations. Ed. Wiley and Sons, New York. 1989.
- WEIR, B.S. Genetic Data analysis. II. Sinauer.1996. Weir B.S. 1996. Genetic Data Análisis II. Ed. Sinauer.
- APUNTES. En el aula virtual de la Universidad de Córdoba.
- DOMINGO, E., BIEBRICHER, C.K., EIGEN, M., HOLLAND J. J. Quasispecies and Rna Virus Evolution: Principlesand Consequences (Molecular Biology Intelligence, Unit 14) Paperback (2002) Landes Bioscience; ISBN:1587060779
- LEWONTIN R.C. La adaptación. Investigación y Ciencia, 26. 1978.
- MARGULIS, L. y D. SAGAN. El origen de las células eucariotas. Mundo Cient. 46: 366-375. 1985.
- TEMPLADO, J. Historia de las teorías evolutivas. Alhambra. 1970. - http://www.ncbi.nlm.nih.gov

Methodology

General clarifications on the methodology (optional)

Those stated by de University of Córdoba.

Methodological adaptations for part-time students and students with disabilities and special educational needs

Those stated by de University of Córdoba. For disabled student, the teacher will adeccuately deal every individual case.

Face-to-face activities

Activity	Large group	Medium group	Small group	Total
Information processing activities	1	-	-	1
Oral communication activities	6	-	-	6
Practical experimentation activities	-	21	6	27
Projects based on the course contents	1	-	-	1
Reading comprehension, listening, visual, etc. activities	17	-	-	17
Summary and consolidation actvities	2	-	-	2

Activity	Large group	Medium group	Small group	Total
Tutorial action activities	3	-	-	3
Written expression activities	3	-	-	3
Total hours:	***33***	***21***	***6***	***60***

Off-site activities

Activity	Total
Exercise and problem solving activities	40
Information processing activities	50
Total hours	***90***

Results of the training and learning process

Knowledge, competencies and skills

CU2	Knowledge and perfection of user level in the area of ICTs.
CB4v4	Capacity to analyse and synthesise.
CB4v9	Critical thinking in line with the scientific method.
CB8v1	Obtain information, design experiments and interpret results.
CB10v14	Use of the Internet as a means of communication and a source of information.
CB12v7	Communicative abilities and public debate.
CB17v3	Computing applied to biology.
CE21v2	Analyse and genetically characterise specimens of human origin.
CE29v1	Carry out phylogenetic analysis.
CE29v2	Phylogeny.
CE63n	Evolutionary mechanisms and models.
CE65n	Conception and design of life and evolution at different levels of organisation.
CE66n	Genetic bases of biodiversity.
CE67n	Carry out genetic counselling.
CE68n	Carry out studies of animal and plant breeding.

Assessment methods and instruments

Intended learning outcomes	Examination	Group or individual globalizing projects	Means of practical execution	Students assignments
CB10v14				X
CB12v7	X	X		X
CB17v3				X
CB4v4	X	X	X	X
CB4v9		X	X	X
CB8v1	X	X	X	X
CE21v2	X			X
CE29v1	X		X	X
CE29v2	X	X	X	X
CE63n	X			X
CE65n			X	X
CE66n	X	X		X
CE67n	X			X
CE68n	X	X		X
CU2	X	X		X
Total (100%)	***60%***	***15%***	***10%***	***15%***
Minimum grade (*)	***5***	***0***	***0***	***0***

(*)Minimum mark (out of 10) needed for the assessment tool to be weighted in the course final mark. In any case, final mark must be 5,0 or higher to pass the course.

General clarifications on instruments for evaluation:

Examination: written tests (short answer and multiple choice).

Means of practical execution: practice. Case studies. Working out problems.

Students assignment: Lessons notebook. Practice notebook. Reports. Ducuments working and images.

Group or individual globalizing projects: Seminar.

Clarifications on the methodology for part-time students and students with disabilities and special educational needs:

Those of UCO rules. For disabled students, teacher will adeccuately deal with very individual case.

Clarifications on the evaluation of the extraordinary call and extra-ordinary call for completion studies:

Those of OCO rules. For extra call the following evaluation tools will be applyed: Log, Exams, Placement reports.

Case study/clinical case discussion/scientific work discussion.

Qualifying criteria for obtaining honors:

A mark higher than 9 is mandatory. The total number will not exceed the 5% of total students. In case of less than 20 students only one Honor Nomination can be awarded.

Sustainable development goals

No poverty
Zero hunger
Good health and well-being
Quality education
Gender equality
Decent work and economic growth
Reduced inequalities
Sustainable cities and communities
Responsible consumption and production
Climate action
Partnerships for the goals

The methodological strategies and the evaluation system contemplated in this Teaching Guide will respond to the principles of equality and non-discrimination and must be adapted according to the needs presented by students with disabilities and special educational needs in the cases that are required. Students must be informed of the risks and measures that affect them, especially those that may have serious or very serious consequences (article 6 of the Safety, Health and Welfare Policy; BOUCO 23-02-23).