Universitat Autònoma de Barcelona

2023/2024

Evolution

Code: 100770
ECTS Credits: 9

Degree	Type	Year	Semester
2500250 Biology	OB	3	2

Contact

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Teaching groups languages

You can check it through this link. To consult the language you will need to enter the CODE of the subject. Please note that this information is provisional until 30 November 2023.

Teachers

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Prerequisites

All biology converges in evolution. Evolutionary analysis integrates and requires knowledge of all disciplines of biology. For an adequate follow-up of the subject it is VERY IMPORTANT to start from the following previous knowledge:

1) Understanding of transversal concepts of mathematics and biometrics (chance, random variable, discrete and continuous variables, mathematical model, distribution functions, Poisson distribution, binomial distribution, multinomial distribution, chi-square distribution, normal distribution, samples and populations, statistics and parameters, measures of central tendency and dispersion, measures of relationship, correlation and causality, statistical inference, sampling error, bias and dispersion, null hypothesis, hypothesis test, confidence interval, level of significance, experimental error, experimental design, replication, nonparametric approximation, pseudo replication, simulation, Bayesian approach). These concepts are taught in Mathematics (1st year) and Biostatistics (1st year).

2) Understanding of the metabolism, physiology, anatomy and taxonomy of prokaryotic and eukaryotic organisms. Fundamental concepts of classical genetics (gene, allele, homozygote and heterozygote, genotype and phenotype, asexual and sexual reproduction, somatic and germinal lines, mitosis and meiosis, gametes and genotypes, principles of allelic segregation in the same locus and in different loci, recombination and linkage), molecular genetics (molecular characters, structure of nucleic acids, concept of gene, structural and functional categories of genomic sequences, types of genetic changes, structure of regulatory genetic regions, physicochemical properties of amino acids, structure of proteins, genetic codes, levels of regulation of gene

expression, mechanisms of pattern formation and morphogenesis, genetic bases of the development and control of gene expression, feedback loops, epigenetics), population genetics (individuals and populations, variability, Hardy-Weinberg equilibrium, departures from random mating, sources of genetic variation, effective population size, migration, genetic drift, natural selection, sexual selection, adaptation, biological efficacy and components, polymorphism and substitution, linkage disequilibrium, gene interaction, epistasis, adaptive landscape, genetic ballast), quantitative genetics (similarity among relatives, monogenic and polygenic inheritance, components of phenotypic variance, additive and dominant genetic variance, heritability, selection differential, response to selection, genotype-environment interaction, genetic background, reaction norm, conflicts and "trade-offs") and ecology (environment, energy flow, ecological niche and habitat, life cycle, reproductive strategies, demographic structure, growth models, carrying capacity, survival curve, acclimatization, competitive exclusion, competition and types, symbiosis and types, trophic level, dispersion, metapopulation, community, ecosystem, ecological network, homeostasis, resilience, ecotone, spatial patterns of diversity). This knowledge is taught in the scientific-technical subjects of Genetics (1st year), Structure and Function of Biomolecules (1st year), Botany (1st year), Zoology (1st year), Cellular Biology Extension (2nd year), Biosignaling and Metabolism (2nd year), Molecular Genetics (2nd year), Advanced Histology (2nd year), Advanced Zoology (2nd year), Microbiology (2nd year), Plant Nutrition and Metabolism (2nd year) and Animal Physiology (2nd year).

Most training resources are in English. To be able to benefit from these resources it is necessary to understand written and spoken discourses in English.

Objectives and Contextualisation

The concept of evolution by natural selection of Charles Darwin is one of the most revolutionary ideas of Western thought.

GLOBAL OBJECTIVES:

a) To raise a vital concern for evolution as a conceptual framework of explanation capable of providing a synthetic view of nature, and of exerting a decisive influence on the understanding of oneself, and one's position in the future of our planet.

b) To provide a solid and integrated knowledge of the core of modern evolutionary theory and its most relevant implications - anthropological, sociological, philosophical. To appreciate how this knowledge comes about and continues to expand through the creativity, the rigorous scientific method, and the cooperation among researchers, within the cultural and social context of each moment.

c) To face the uncertainty associated with change and the multiple perspectives of knowledge and reality.

d) Promotion of intellectual autonomy and personal creative independence in the search and acquisition of knowledge.

e) To transfer theoretical approaches to concrete situations, demonstrating the applicability of evolutionary theory (e.g. in health sciences, agriculture and conservation), and the positive impact that a citizen with a solid knowledge of this subject can have in society.

TRAINING OBJECTIVES:

a) Development of syntactic-semantic skills for the transmission of evolutionary ideas with rigour, avoiding teleologisms of language. Evolution is a contingent historical process, without purpose or direction.

b) Acquisition of a perspective of all the biological disciplines articulated ina coherent conceptual frame of evolution of the life on the Earth.

c) Knowledge of the history and social relations of evolutionary thought, including the most recent discussions on the need for revision of the New Synthesis. The theory of biological evolution is usually identified only with the figure of Charles Darwin.

d) Knowledgeof the main empirical evidence on which modern evolutionary theory is based. Biological evolution is such a solid scientific theory that in practice it can be considered a fact.

e) Knowledge of the main theories on the origin of life, the nature of the last common ancestor and the history of its diversification (extinction) in present life forms, emphasizing the great evolutionary transitions, in connection with the dynamics of the planet. The purpose of evolutionary biology is to interpret phenomena that cannot be understood without knowing the past.

f) Understanding of basic methodological concepts and approaches (based on tacit premises, based on explicit models) for the inference of evolutionary relationships (genealogies, phylogenies) between organisms at different taxonomic levels (populations, species, higher order categories), and its dating (molecular clocks), from characters of diverse nature (genetic sequences, molecular markers, physiological or anatomical properties).

g) Understanding of the method of evolutionary analysis. In a broad sense, evolution is offspring with modification. Evolutionarily more related organisms tend to have more similar biological properties. Through the evolutionary approach it is possible to predict the biology of an organism by comparison with related organisms and on the contrary, the comparison is the most general method of inquiry into the regularities of evolutionary change.

h) Understanding of the genetic basis of evolution (structural variants vs. regulatory variants) andthe connections between evolution and development.

i) Understanding the causes and mechanisms of the evolutionary process in its two dimensions: anagenesis and cladogenesis, integrating classical approaches to the study of evolution with modern techniques of genetic analysis (genetic sequences, molecular markers, genetic manipulation) and bioinformatics (analysis sequence comparison).

j) Understanding of human nature and diversity, and the connections and interrelationships of our species in the evolutionary scheme of life on Earth.

k) Understanding of evolutionary biology not as a discipline of exclusively formal interest, but as fundamental knowledge with practical implications in multiple areas. The rapid advancement of evolutionary biology has sparked the development of powerful technologies for health monitoring, law enforcement, agriculture, ecology, and the treatment of all kinds of design and optimization problems.

Competences

- Act with ethical responsibility and respect for fundamental rights and duties, diversity and democratic values.
- Analyse and interpret the origin, evolution, diversity and behaviour of living beings.
- Be able to analyse and synthesise
- Be able to organise and plan.
- Develop a historical vision of biology.
- Make changes to methods and processes in the area of knowledge in order to provide innovative responses to society's needs and demands.
- Students must be capable of applying their knowledge to their work or vocation in a professional way and they should have building arguments and problem resolution skills within their area of study.
- Students must be capable of collecting and interpreting relevant data (usually within their area of study) in order to make statements that reflect social, scientific or ethical relevant issues.
- Students must be capable of communicating information, ideas, problems and solutions to both specialised and non-specialised audiences.
- Students must develop the necessary learning skills to undertake further training with a high degree of autonomy.
- Students must have and understand knowledge of an area of study built on the basis of general secondary education, and while it relies on some advanced textbooks it also includes some aspects coming from the forefront of its field of study.

- Take account of social, economic and environmental impacts when operating within one's own area of knowledge.
- Take sex- or gender-based inequalities into consideration when operating within one's own area of knowledge.
- Understand the biological characteristics of human nature.
- Understand the processes that determine the functioning of living beings in each of their levels of organisation.

Learning Outcomes

1. Analyse a situation and identify its points for improvement.
2. Analyse the sex- or gender-based inequalities and the gender biases present in one's own area of knowledge.
3. Be able to analyse and synthesise.
4. Be able to organise and plan.
5. Clearly present the difference between evolutionary patterns and processes.
6. Combine historical thought with scientific thought.
7. Critically analyse the principles, values and procedures that govern the exercise of the profession.
8. Explain the conflicts generated between the different levels of biological organisation.
9. Explain the importance of models in biology.
10. Explain the importance of phylogenetic relations in data analysis.
11. Explain the old dichotomy between nature and environment.
12. Explain what makes us different to the other species and why.
13. Explain why biology is a separate science.
14. Identify and present the problems associated with the answer to the big question: how did life arise and evolve on our planet?
15. Identify the fallacies in non-evolutionary discourse.
16. Interpret phylogenetic reconstruction.
17. Justify the relative importance of the contingent and functional aspects in the history of life.
18. Propose new methods or well-founded alternative solutions.
19. Propose projects and actions that incorporate the gender perspective.
20. Propose viable projects and actions to boost social, economic and environmental benefits.
21. Students must be capable of applying their knowledge to their work or vocation in a professional way and they should have building arguments and problem resolution skills within their area of study.
22. Students must be capable of collecting and interpreting relevant data (usually within their area of study) in order to make statements that reflect social, scientific or ethical relevant issues.
23. Students must be capable of communicating information, ideas, problems and solutions to both specialised and non-specialised audiences.
24. Students must develop the necessary learning skills to undertake further training with a high degree of autonomy.
25. Students must have and understand knowledge of an area of study built on the basis of general secondary education, and while it relies on some advanced textbooks it also includes some aspects coming from the forefront of its field of study.
26. Summarise evolutionary thought and integrate the different levels of biological organisation into a coherent approach.
27. Summarise the historical development of theories of evolution.

Content

PART I: INTRODUCTION

Topic 1: Introduction to evolutionary thinking.

Topic 2: Origin of life.

PART II: EVOLUTIONARY PROCESSES

Topic 3: Origin of variation.

Topic 4: Molecular evolution.

Topic 5: Population structure.

Topic 6: Selection and adaptation.

Topic 7: Sexual selection, social and genetic conflicts.

Topic 8: Generating processes of variation at the morphological level.

Topic 9: Generating processes of variation at the level of molecular structure.

Topic 10: Evolution of the processes generating variation.

Topic 11: Species concepts, models and mechanisms of speciation.

Topic 12: Speciation and chromosomal variation.

PART III: EVOLUTIONARY PATTERNS

Topic 13: History of life on earth I. Geological history.

Topic 14: History of life on earth II. Origin and diversification of prokaryotes.

Topic 15: History of life on Earth III. The fossil record.

Topic 16: Phylogenetic reconstruction.

Topic 17: Evolution rates.

Topic 18: Adaptive radiation and coevolution.

Topic 19: Mass extinctions and diversification.

Topic 20: Human evolution.

PART IV: EVOLUTION AND SOCIETY

Topic 21: Recurrent and frequent errors in the study and understanding of evolution.

Methodology

The course aims to provide students with a general introduction to the fundamental concepts of thought and evolutionary theory.

Theory classes: The student acquires the scientific knowledge of the subject by attending theory classes.

Master seminars: In some topics, the theory is complemented by seminars of specialists in applications of evolutionary biology.

Seminars in which classic scientific articles on evolutionary biology will be discussed (between students and between students and the teacher).

Classes of practices to review and solidify the concepts introduced in theory.

Doubt-solving tutorials and personalized help.

Seminars:

- The seminars will consist of the discussion of articles that the students will have read previously. The list of all items will be posted in the first week of the course. The seminars will be evaluated based on the answers that each student gives to the questions that will be asked about the articles discussed.

Practices:

1. Simulation of evolution with the Populus program (computer room).

2. Phylogenetic reconstruction exercises in specific plant groups (computer room).

3. Distances between populations and intra-specific phylogeny (Networks) (computer room).

4. Morphological study of hominoid and hominid skulls, as well as the postcranial skeleton of some primates in order to observe those evolutionary trends within the group and the distinctive human characters (laboratory practice).

Annotation: Within the schedule set by the centre or degree programme, 15 minutes of one class will be reserved for students to evaluate their lecturers and their courses or modules through questionnaires.

Activities

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Lab Practicum	20	0.8	9, 16, 10, 3
Theory lectures	45	1.8	6, 5, 8, 9, 11, 12, 14, 15, 16, 10, 17, 13, 27, 26, 3
Type: Supervised			
Tutorials	5	0.2	3
Type: Autonomous			
Reading and discussion of articles	30	1.2	6, 5, 8, 9, 11, 12, 14, 15, 16, 10, 17, 13, 27, 26, 3
Literature search	26	1.04	3
Studying	90	3.6	3

Assessment

First partial exam, 50% of the syllabus and 35% of the grade.

Second partial exam, 50% of the syllabus and 35% of the grade.

Practices: exercises to be delivered during the practice or a few days later according to the practice, 15% of the grade of the subject.

Seminars, 15% of the grade. The seminars will be evaluated in writing with the resolution of questions that will be asked about the articles discussed.

Students who have obtained a grade lower than 4.5 (out of 10) in any of the partial exams will not be able to weight it with the grade obtained in the seminars and practicals and, therefore, will have to take the recovery exam in the test of final maturity In the latter case, to pass the subject you will need to have a minimum of 5 in this last exam.

To participate in the recovery, students must have been previously evaluated in a set of activities whose weight is equivalent to a minimum of two thirds of the total grade of the subject or module. Therefore, students will obtain the grade of "Non-Evaluable" when the assessment activities performed have a weighting of less than 67% in the final grade.

This subject considers the single evaluation system. In this sense, this comprises a single synthesis exam that includes: 1) the contents of the entire theory program with a weight of 70%, 2) questions corresponding to seminars with a weight of 15%, and 3) questions corresponding to the laboratory and computer classroom practices with a weight of 15%. The grade obtained in this synthesis exam is 100% of the final grade for the subject. The single evaluation test will be carried out coinciding with the same date set in the calendar for the last continuous evaluation exam (2nd partial) and the same system will be applied in case of recovery.

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Partial exam 1	35% de la nota global	3	0.12	6, 5, 8, 9, 14, 15, 17, 13, 27, 26, 3
Partial examen 2	35%	3	0.12	6, 5, 8, 9, 11, 12, 14, 15, 16, 10, 17, 13, 27, 26
Participación en los seminarios	15% de la nota global	1	0.04	2, 19, 20, 25, 24, 23, 21, 22, 26, 3, 4
Prueba práctica	15% de la nota global	2	0.08	7, 1, 16, 10, 18, 3

Bibliography

General

Barton, N. H., D. E. G. Briggs, J. A. Eisen, D. B. Goldstein, N. H. Patel. 2007. Evolution. Cold Spring Harbor Laboratory Press, New York.

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-Evolutionary Developmental Biology: A Reference Guide. Editors: Nuno de la Rosa, Laura, Müller, Gerd (Eds.) 2021. Springer.

-Arthur, W. Understanding Evo-devo. Cambridge University Press. 2021.

Specific

Boy, R., Silk, J. B. 2001. Cómo evolucionaron los humanos. Ariel.

King, M. 1993. Species evolution. The role of chromosome change. Cambridge Univ. Press.

Raven, H., R. F. Evert, S. E. Eichhorn. 1999. Biología Vegetal. Ediciones Omega.

Stahl, D.A. Brock. Biologia de los microorganismos (12th edition). Pearson Education S.A. 2015.

Willis, K. J., McElwain, J. C. 2014. The Evolution of Plants (2nd edition). Oxford.

Software

-Arlequin http://cmpg.unibe.ch/software/arlequin35/

-Network https://www.fluxus-engineering.com/sharenet.htm

-Neighbor (Phylip) https://evolution.gs.washington.edu/phylip/doc/neighbor.html

-Populus: https://cbs.umn.edu/populus

-FigTree http://tree.bio.ed.ac.uk/software/figtree/

-Gblocks http://molevol.cmima.csic.es/castresana/Gblocks.html

-raxmlGUI https://antonellilab.github.io/raxmlGUI/

-SeaView http://doua.prabi.fr/software/seaview

-TNT http://www.lillo.org.ar/phylogeny/tnt/