Universitat Autònoma de Barcelona

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Evolution

Code: 100770
ECTS Credits: 9

Degree	Type	Year	Semester
2500250 Biology	OB	3	2

Contact

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Use of languages

Principal working language: spanish (spa)
Some groups entirely in English: No
Some groups entirely in Catalan: No
Some groups entirely in Spanish: Yes

Teachers

Assumpció Malgosa Morera
Merce Galbany Casals
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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), Animal Physiology (2nd year) and Human Biology (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 competences for the transmission of evolutionary ideas with rigor, avoiding teleologism of language. Evolution is a contingent historical process, without purpose or direction.

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

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

d) Knowledge of 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 as a fact.

e) Knowledge of the main theories about the origin of life, the nature of the last common ancestor and the history of its diversification (extinction) in the present forms of life, 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 concepts and methodological 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 descent with modification. Related organisms tend to have similar biological properties. Through the evolutionary approach, it is possible to predict the biology of an organism by comparison with related organisms.

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

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

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 advance of evolutionary biology has triggered the development of powerful technologies for health monitoring, law enforcement, agriculture, ecology, and the treatment of all kinds of design and optimization problems.

Skills

- To analyse and interpret the origin, evolution, diversity and behaviour of living beings.
- To understand the processes that determine the functioning of living beings in each of their levels of organization.
- To understand the biological characteristics of human nature.
- To develop independent learning strategies.
- To develop a critical thinking and reasoning. To communicate them effectively.
- To develop a historical vision of biology.
- Respect towards the diversity and plurality of ideas, people and situations.
- To be able to analyse and synthesize.
- Capacity for organization and planning.

Learning outcomes

1. Combine historical thinking with scientific thinking.

2. Develop autonomous learning strategies.

3. Develop a critical thinking and reasoning.

4. State in a clear way the difference between patterns and process in evolution.

5. Explain the conflicts that are generated between the different levels of biological organization.

6. Explain the importance of models in biology.

7. Explain the old dichotomy between nature and environment.

8. Explain what makes us different from the rest of the species and why.

9. Identify and enunciate the problems associated with the answer to the big question: how did life on our planet emerge and evolve?

10. Identify fallacies in non-evolutionist discourses.

11. Interpret phylogenetic reconstruction.

12. Justify the importance of phylogenetic relationships in data analysis.

13. Justify the relative importance of contingent and functional aspects in the history of life.

14. Justify why biology is an autonomous science.

15. Respect the diversity and plurality of ideas, people and situations.

16. Summarize the historical development of evolutionary theories.

17. Summarize evolutionary thinking and integrate the different levels of biological organization under a coherent perspective.

18. Be able to analyze and synthesize.

19. Have the capacity for organization and planning.

Skills

- 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.
- Develop critical thinking and reasoning and communicate ideas effectively, both in the mother tongue and in other languages.
- Develop independent learning strategies.
- Respect diversity in ideas, people and situations
- 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. Be able to analyse and synthesise.
2. Be able to organise and plan.
3. Clearly present the difference between evolutionary patterns and processes.
4. Combine historical thought with scientific thought.
5. Develop critical thinking and reasoning and communicate ideas effectively, both in the mother tongue and in other languages.
6. Develop independent learning strategies.
7. Explain the conflicts generated between the different levels of biological organisation.
8. Explain the importance of models in biology.
9. Explain the importance of phylogenetic relations in data analysis.
10. Explain the old dichotomy between nature and environment.
11. Explain what makes us different to the other species and why.
12. Explain why biology is a separate science.
13. Identify and present the problems associated with the answer to the big question: how did life arise and evolve on our planet?
14. Identify the fallacies in non-evolutionary discourse.

15. Interpret phylogenetic reconstruction.
16. Justify the relative importance of the contingent and functional aspects in the history of life.
17. Respect diversity in ideas, people and situations.
18. Summarise evolutionary thought and integrate the different levels of biological organisation into a coherent approach.
19. Summarise the historical development of theories of evolution.

Content

PARTE I: INTRODUCTION

Topic 1: INTRODUCTION TO EVOLUTIONARY THOUGHT.

Topic 2: GEOLOGICAL HISTORY OF THE EARTH..

Topic 3: THE ORIGIN OF LIFE.

Topic 4: ORIGIN AND DIVERSIFICATION OF PROCARIOTS.

PART II: EVOLUTIONARY PROCESSES

Topic 5: ORIGIN OF VARIATION.

Topic 6: MOLECULAR EVOLUTION.

Topic 7: EVOLUTION OF COMPLEX CHARACTERS.

Topic 8: POPULATION STRUCTURE.

Topic 9: SELECTION AND ADAPTATION.

Topic 10: LIFE HISTORY EVOLUTION.

Topic 11: CONFLICT AND COOPERATION.

Topic 12: SPECIES CONCEPTS AND MODELS OF SPECIATION.

PART III: EVOLUTIONARY PATTERNS

Topic 13: PHYLOGENETIC RECONSTRUCTION.

Topic 14: ADAPTIVE RADIATIONS AND COEVOLUTION.

Topic 15: MASSIVE EXTINCTIONS AND DIVERSIFICATION.

Topic 16: CYTOGENETIC APPLICATIONS TO THE STUDY AND EVOLUTION OF SPECIES.

Topic 17: HUMAN EVOLUTION.

Topic 18: EVOLUTIONARY RATES.

Topic 19: MACROEVOLUTION.

Methodology

The contents of the subject will allow students to receive a general introduction to the basic concepts of evolutionary theory.

Theory classes: The student acquires the scientific knowledge of the subject by attending theory classes that will complement the personal study of the topics discussed.

Master seminars: The theory classes will be complemented by seminars taught by several specialists in various disciplines.

Students presentations: Students will present and discuss various articles that cover several relevant aspects of Evolution.

Teaching Practices: Essential module to understand and put into practice the knowledge acquired in theory classes. Various concepts and methods studied are reviewed.

Tutorials: They aim to provide guidance and personalized help to the student by clarifying doubts about the subjects, the direction and orientation of the proposed seminars, and the comment and discussion of the results of the evaluations.

Activities

Title	Hours	ECTS	Learning outcomes
Type: Directed			
Clases de Teoría	45	1.8	4, 6, 5, 3, 7, 8, 10, 11, 13, 14, 15, 9, 16, 12, 17, 19, 18, 1
Exposición de Trabajos	10	0.4	6, 5, 17, 1
Prácticas de Laboratorio	20	0.8	6, 5, 8, 15, 9, 17, 1
Type: Supervised			
Tutorías	5	0.2	6, 5, 17, 1
Type: Autonomous			
Búsqueda bibliográfica	15	0.6	6, 5, 1
Consulta de textos recomendados	30	1.2	4, 6, 3, 7, 8, 10, 11, 13, 14, 15, 9, 16, 12, 17, 19, 18, 1
Estudio	90	3.6	6, 5, 17, 1

Evaluation

The competences of this subject will be qualified through continuous evaluation, which includes written exams and individual assignments, as well as the development of tutorials.

The evaluation system is organized into 3 modules, each of which will be assigned a specific weight in the final grade:

Module of written tests. Two written tests with a global weight of 30% each.

Practice module, with a global weight of 20%.

Module of deliveries and presentations or seminars, with a global weight of 20%.

To be eligible for the retake process, the student should have been previously evaluated in a set of activities equaling at least two thirds of the final score of the course or module. Thus, the student will be graded as "No Avaluable" if the weighthin of all conducted evaluation activities is less than 67% of the final score.

Attendance to practical sessions (or field trips) is mandatory. Students missing more than 20% of programmed sessions will be graded as "No Avaluable".

Evaluation activities

Title	Weighting	Hours	ECTS	Learning outcomes
Entregas y presentaciones	20% de la nota global	0	0	6, 5, 17, 1, 2
Prueba de recuperación final	El equivalente a una prueba parcial o a las dos, dependiendo del caso	4	0.16	4, 5, 3, 7, 8, 10, 11, 13, 14, 15, 9, 16, 12, 19, 18, 1
Prueba práctica	20% de la nota global	3	0.12	6, 5, 15, 9, 1
Pruebas parciales	60% de la nota global	3	0.12	4, 6, 5, 3, 7, 8, 10, 11, 13, 14, 15, 9, 16, 12, 19, 18, 1

Bibliography

General

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Specific

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