

Evolution

Code: 107523
ECTS Credits: 6

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Degree	Type	Year
Biology	OB	2

Contact

Name: Maria Cinta Pegueroles Queralt

Email: cinta.pegueroles@uab.cat

Teaching groups languages

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Prerequisites

All biology converges on evolution. Evolutionary analysis integrates and requires knowledge from all biological disciplines. For proper follow-up of the course, it is very important to have the following prior knowledge:

1. Understanding of transversal concepts in mathematics and biometrics (chance, randomness, discrete and continuous variables, mathematical model, distribution functions, binomial distribution, normal distribution, samples and populations), statistical parameters (measures of central tendency and measures of dispersion, correlation and causality, statistical inference, sampling error, bias and null hypothesis, hypothesis testing, experimental confidence interval, significance level, error, experimental design, replication, non-parametric approach, pseudoreplication, simulation, Bayesian approach). These concepts are taught in the courses Mathematics (1st year) and Biostatistics (1st year).
2. Understanding of genetics, anatomy, and taxonomy of prokaryotic and eukaryotic organisms. Fundamental concepts of classical genetics (gene, allele, homozygous and heterozygous, genotype and phenotype, asexual and sexual reproduction, somatic and germ line, mitosis and meiosis, gametes, types of genetic changes, genetic code), population genetics (individuals and populations, variability), ecology (environment, energy flow, ecological niche and habitat, life cycle, growth models, carrying capacity, competitive exclusion, competition and types, symbiosis, spatial patterns of diversity). These topics are covered in the courses Genetics (1st year), Structure and Function of Biomolecules (1st year), Botany (1st year), Zoology (1st year), Cellular Biology (1st year).

Part of the course materials will be in English. To benefit from these resources, it is necessary to be able to understand written texts and spoken discourse 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 in a 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) 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 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) and the 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.

Learning Outcomes

1. CM19 (Competence) Explain evolutionary ideas with rigour, avoiding teleological language and fallacies typical of non-evolutionary discourses.
2. CM20 (Competence) Build an integrated and critical vision of the process of origin and evolution of living beings, as a fundamental pillar for understanding our own evolution as a species.
3. KM33 (Knowledge) Define the patterns and processes of biological evolution, clearly distinguishing both concepts.
4. KM34 (Knowledge) Identify the importance of phylogenetic relationships in the analysis of evolutionary data as a tool that provides analytical objectivity in problem solving.
5. SM28 (Skill) Use evolutionary concepts as a tool to solve problems that allow understanding the mechanisms of life, at all levels, from molecular to ecosystems.
6. SM29 (Skill) Apply the bases of population genetics and the evolutionary processes that generate diversity in genomes (selection, mutation, migration and drift) to the resolution of evolutionary, diversity, species conservation, biomedical, etc. problems.

Content

PART I: INTRODUCTION

Topic 1: Introduction to evolutionary thought.

PART II: EVOLUTIONARY PROCESSES

Topic 2: Origin of genetic variation.

Topic 3: Populations in equilibrium.

Topic 4: Population structure and intraspecific variability.

Topic 5: Selection and adaptation.

Topic 6: Sexual, social selection, and coevolution.

PART III: MOLECULAR EVOLUTION

Topic 7: Molecular evolution.

Topic 8: Phylogenetic reconstruction.

Topic 9: Processes generating variation at the molecular level.

Topic 10: Processes generating variation at the morphological level.

PART IV: EVOLUTION OF LIFE

Topic 11: Origin of life.

Topic 12: Origin and diversification of prokaryotes and eukaryotes.

Topic 13: History of life on Earth. The fossil record.

Topic 14: Concepts of species, models, and mechanisms of speciation.

PART V: EVOLUTION AND SOCIETY

Topic 15: Recurring and frequent errors in the study and understanding of evolution.

Topic 16: Impact of evolutionary theory on other disciplines: forensic genetics.

Activities and Methodology

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Practicals	9	0.36	KM34, SM28, KM34
Theory lectures	30	1.2	CM19, CM20, KM33, KM34, SM28, SM29, CM19
Type: Supervised			
Tutorials	3	0.12	CM20, CM20
Type: Autonomous			
Literature search	19	0.76	CM19, CM20, KM33, KM34, SM28, SM29, CM19
Seminars	20	0.8	CM20, KM34, SM28, SM29, CM20
Studying	60	2.4	CM19, CM20, KM33, KM34, SM28, SM29, CM19

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

Lecture classes: Students acquire the scientific knowledge of the subject by attending theoretical lectures.

Guest seminars: For some topics, the theory is complemented by seminars given by specialists in evolutionary biology applications.

Seminars with various activities aimed at reinforcing key theoretical concepts in evolutionary biology:

Problem-Based Learning (PBL) activities, discussion of scientific articles, and problem-solving.

Practical sessions to review and consolidate the concepts introduced in the lectures.

Tutorials for resolving doubts and offering personalized support.

Seminars:

Most seminars will be dedicated to conducting a Problem-Based Learning (PBL) activity. Students will be provided with texts describing a biological curiosity, which they must investigate to determine the most plausible evolutionary explanation. To do this, students will organize into groups (and subgroups) and carry out a coordinated and structured information search. In the first phase, they will collect information using reliable sources and redefine the questions to be addressed. This information will be presented to the rest of the class, and the instructor will provide feedback. Students will continue working until they complete a final presentation, which they will deliver to classmates who have worked on different topics.

Assessment will consider: the group grade for the presentation, individual performance on a questionnaire covering all PBL cases, and individual participation in class. In addition to the PBL activities, students will also discuss scientific articles and solve problems. This content will be assessed through multiple-choice questions included in the course exams.

Practical sessions:

1. Simulation of evolution using the Populus software (computer lab, 3 hours).
2. Interpretation of population data, phylogenetic reconstructions, and evolution of nucleotide variability using epidemiological data from viruses (computer lab, 3 hours).
3. Identification and characterization of evolutionary processes (laboratory session).

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.

Assessment

Continuous Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Discussion in the seminars	15% of the grade	1	0.04	CM20, KM34, SM28, SM29
Partial exam 1	35% of the grade	3	0.12	CM19, CM20, KM33, KM34, SM28, SM29
Partial exam 2	35% of the grade	3	0.12	CM19, CM20, KM33, KM34, SM28, SM29
Practical exam	15% of the grade	2	0.08	KM34, SM28

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 must obtain a grade of 4.5 or higher (out of 10) in each of the midterm exams in order to average them with the grades from seminars and practicals. Any midterm exam with a grade below 4 must be retaken in the resit exam. To pass the course, students must achieve a minimum overall grade of 5, based on the weighted average of theory, seminars, and practicals.

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.

Students may choose to retake one of the midterm exams to improve their grade, but they must notify in advance, and the previous exam grade will not be kept.

For this course, the use of Artificial Intelligence (AI) technologies is allowed exclusively for support tasks, such as bibliographic or information searches, text correction, or translations. Students must clearly identify which parts have been generated using this technology, specify the tools used, and include a critical reflection on how these have influenced the process and the final outcome of the activity. Lack of transparency regarding the use of AI in this evaluable activity will be considered a breach of academic honesty and may result in a partial or total penalty on the activity's grade, or more severe sanctions in serious cases.

Bibliography

-General

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-Specific:

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Software

Populus: <https://cbs.umn.edu/populus>

Groups and Languages

Please note that this information is provisional until 30 November 2025. You can check it through this [link](#). To consult the language you will need to enter the CODE of the subject.

Name	Group	Language	Semester	Turn
(PAUL) Classroom practices	121	Catalan	second semester	morning-mixed
(PAUL) Classroom practices	122	Catalan	second semester	morning-mixed
(PLAB) Practical laboratories	121	Catalan	second semester	morning-mixed
(PLAB) Practical laboratories	122	Catalan	second semester	morning-mixed
(PLAB) Practical laboratories	123	Catalan	second semester	morning-mixed
(PLAB) Practical laboratories	124	Catalan	second semester	morning-mixed
(TE) Theory	12	Catalan	second semester	morning-mixed
